DESIGN AND DEVELOPMENT OF DATABASE FOR TOOL PLANNING AND CONTROL IN FMS

By

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INDUSTRIAL AND MANAGEMENT ENGINEERING PROGRAMME

INDIAN INSTITUTE OF TECHNOLOGY, KANPUR

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By

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CERTIFICATE

This is to certify that the present work on "Design and Development of Database for Tool Planning and Control in FMS," by B.V. Gopinath has been carried out under my supervision and has not been submitted elsewhere for the award of a degree.

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ABSTRACT

Tool Management is very critical for effective and uninterrupted operation of an FMS. Tool management normally comprises of (i) selection of tool and cutting conditions with the objectives of minimizing the cost of manufacturing operations and maximizing the rate of production for a given part design and specifications and machine tool characteristics, and (ii) Tool Planning and Control with the objectives of making available the right type of tool on the machine at right time while keeping the overall investment in tools a minimum.

In the present thesis, several aspects of Tool Planning and Control are studied and the steps are identified. It is concluded that a computer-aided procedure integrating the functions of assigning the tools to various operations, procurement and replacement of tools, scheduling the regrinding of tools would meet to a great extent the objectives of Tool Planning and Control.

With these in view, Systems Analysis is carried out and the functions and inputs are identified along with the departments of the organization who may possibly interact with Tool Planning and Control. To meet these requirements a Tool Information System is designed to provide tool scheduling report, tool procurement plan, tool regrinding report, tool and machine utilization reports and a comprehensive report about tools. A database is designed for the information system using DBMS-10 and is implemented on DEC-1090 computer at I.I.T. Kanpur.

CONTENTS

CHAPTER I

INTRODUCTION

1.1 DEVELOPMENT OF FMS:

With the recent trend of increasing product design complexity coupled with the requirement of higher reliability, competitive market and diversified user requirements, the product life cycle is shortened. Consequently, a manufacturing system should be equipped to produce a variety of products with least possible lead time at a minimum possible cost. Computer Integrated Manufacturing Systems (CIMS) are designed to meet these requirements.

Conventional Manufacturing Systems and CIMS:

For producing few varieties of parts in large volumes at high output rates, Transfer Lines are very efficient. These highly mechanised lines, however, are inflexible and cannot tolerate variations in parts design.

For job shop and small batch manufacturing, on the other hand, stand alone NC machine tools have proved to be quite appropriate. In terms of manufacturing efficiency and productivity, a gap exists between the high-production rate transfer machines and highly flexible NC machines. CIMS are

designed to fill this gap by combining the benefits of highly productive but inflexible transfer line, and a flexible but inefficient and low volume job shop. The relative position of the CIMS concept is illustrated in Fig. 1.1 [5].

Types of CIMS.

CIMS covering the medium part variety and medium production volume, can be further divided into finer categories. These categories represent different levels of compromise between the objectives of flexibility and production capacity. They are:

(i) Special Manufacturing System

(ii) Manufacturing Cell

(iii) Flexible Manufacturing System (FMS)

Fig. 1.2 [5] illustrates the general application guidelines of each of the three types.

The Special Manufacturing System is designed to produce a very limited number of different parts in the same manufacturing family. It is the least flexible CIMS. Manufacturing cell is the most flexible but generally has the lowest production rate of the three types. It is at the opposite end of the mid volume range. The Flexible Manufacturing System (FMS) covers a wide middle territory within the mid volume, mid variety production range.

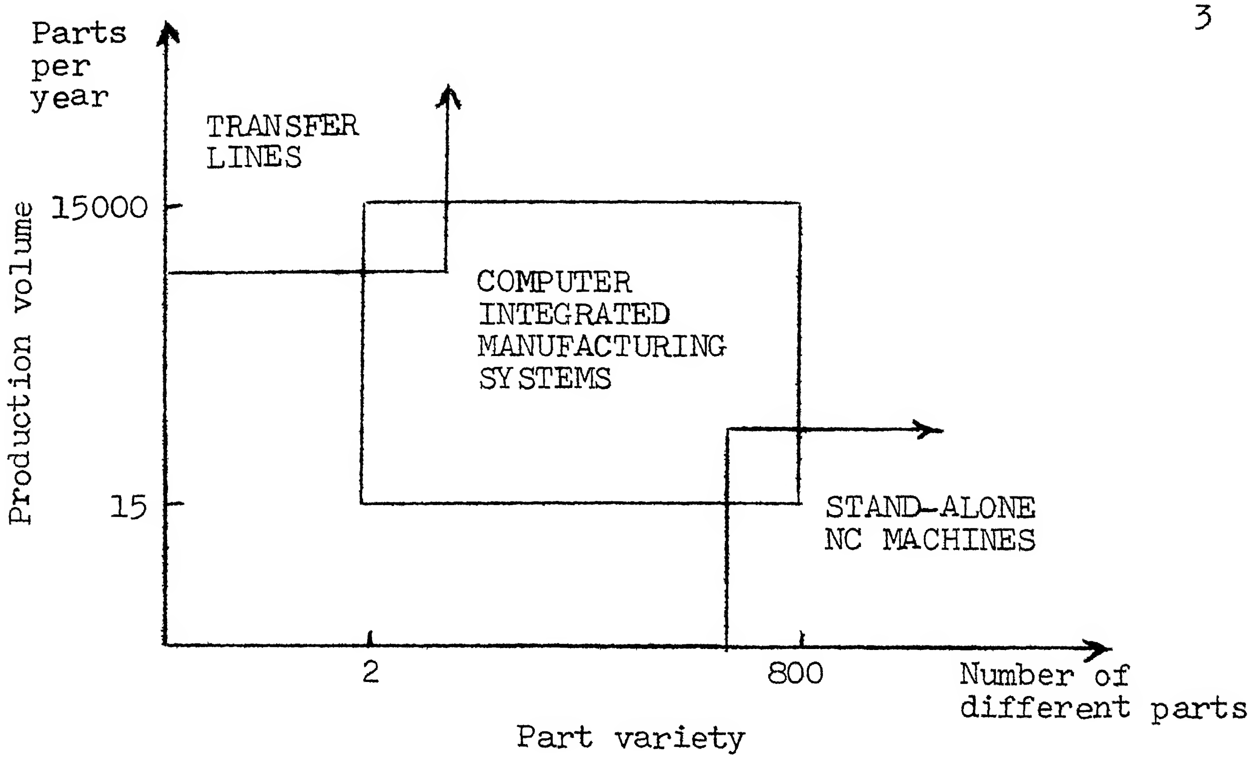

Fig. 1.1: General application guidelines for CIMS.

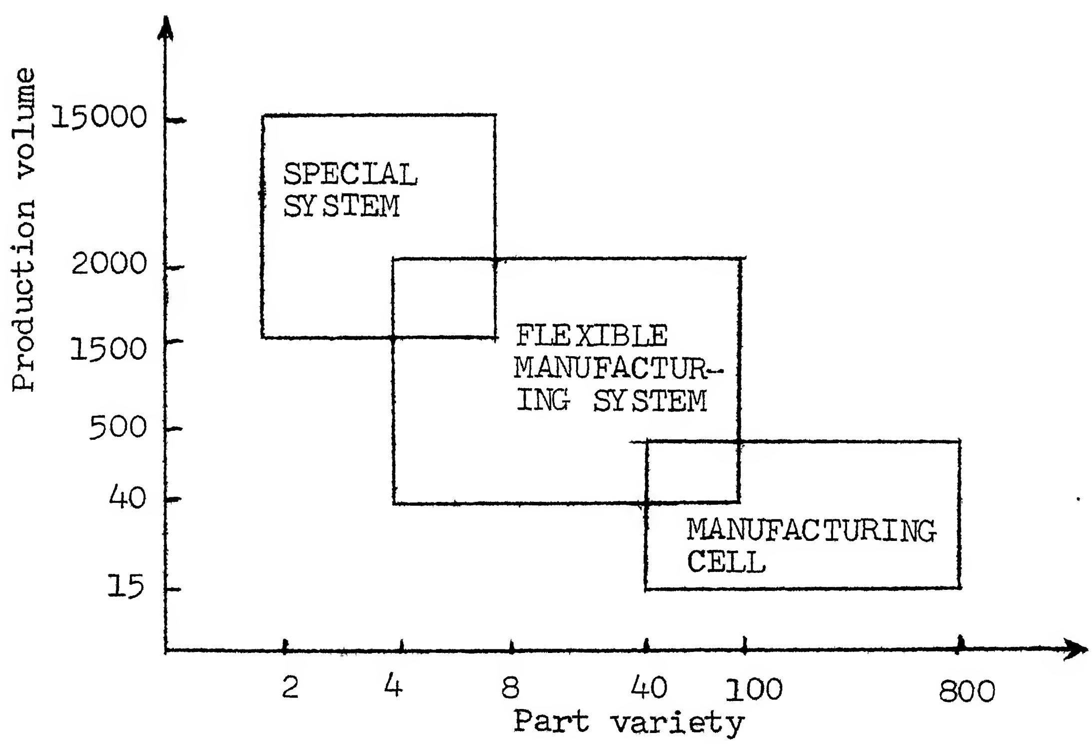

Fig. 1.2: Application guidelines for the three types of CIMS.

Flexible Manufacturing Systems (FMS):

An FMS in general, consists of a group of processing stations-numerically controlled machines, machining centres with automatic tool interchange capabilities and robots - linked together with an automatic material (work part) handling system and automatic storage and retrieval system that operate as an integrated system under the control of a central computer.

In FMS, most of the real time activities such as the actual machining operations, part movements and tool interchanges are controlled by computers. The word flexibility, in FMS, connotes:

(1) Product flexibility (being able to produce a variety of products)

(2) Process flexibility (being able to generate alternative routes for various operations), and

(3) Program flexibility (being able to execute the operations unattended and in uninterrupted manner with the help of automated fixturing, inspection and feedback devices).

Advantages of Flexible Manufacturing Systems:

Flexible Manufacturing Systems offer the following advantages over the conventional systems:

(a) Increased Machine Utilization

(b) Reduced Direct and Indirect Labour

(c) Reduced Manufacturing lead time

(d) Lower in-process inventory

(e) Scheduling flexibility

(f) Greater productivity

(g) Greater consistency and repeatability of the product

(h) Increased reliability of the production system, and

(i) Swifter response to new production requirements.

1.2 PRODUCTION MANAGEMENT PROBLEMS IN FMS:

The following production management problems have special significance to FMS.

(1) Production Planning,

(2) Process Planning, and

(3) Production Scheduling.

1.2.1 Production Planning:

Production Planning in this context is used to represent the task of preparing Master Schedule. This becomes critical in systems like FMS, which are used to manufacture a wide variety and a large number of different parts and also where large investment is made in manufacturing facilities. The following five production Planning problems have been identified [8].

(i) Part Type Selection Problem:

To determine a subset of part types for immediate and simultaneous processing from the total set of part types that have production requirements.

(ii) Machine Grouping Problem:

To partition the machines into machine groups in such a way that each machine in a particular group is able to perform the same set of operations.

(iii) Production Ratio Problem:

To determine the relative ratios at which the part types selected in problem (i) will be produced.

(iv) Resource Allocation Problem:

To allocate the limited number of pallets and fixtures of each type among the selected part types.

(v) Loading Problem:

To allocate the operations and the required tools of the selected part types among the machine groups subject to technological and capacity constraints of FMS.

1.2.2 Process Planning:

Process planning involves determining the sequence of manufacturing operations required to produce a certain product. The resulting operation sequence is called a Route Sheet,

which is the listing of production operations and associated machine tools for work part. The problems of determining appropriate cutting conditions and setting the time standards for the machining operations are also parts of process planning.

1.2.3 Production Scheduling:

Production scheduling involves the assignment of start times and due dates for the components to be processed. Production scheduling is complex due to the following three reasons:

(a) The number of machines in a shop are limited and the machines are of different types. A machine can perform several operations, and an operation can be performed by several machines.

(b) A part may have alternative process routings that can be followed.

(c) The number of individual parts to be scheduled is usually large.

CHAPTER II

TOOL MANAGEMENT IN FMS

Tool Management is very critical for effective and uninterrupted operation of an FMS. Following aspects of FMS tend to enhance the significance of tool management as compared to the conventional manufacturing systems:

(1) Flexible Scheduling

(2) Need for swifter response to new production requirements

(3) Unmanned operational needs

(4) Need for greater utilization of the production systems where the investment is reasonably large

(5) Shorter lead time requirements.

Tool management consists of selecting the tool and cutting conditions, and Tool Planning and Control.

2.1 SELECTION OF TOOLS AND CUTTING CONDITIONS:

The types of tools are selected based on the part design, process requirement and the work piece characteristics. This is based on the knowledge of manufacturing technology. Usually the sequence of operations is determined by the part design. However, information regarding the availability of

tools in the system is used to finalize the production schedule while maintaining the technological constraint of sequence of operations. This may, therefore, sometimes lead to find the optimal schedule with tool availability as a constraint.

Cutting conditions for the machining operations usually consist of the speed, feed and depth of cut. Depth of cut is usually predetermined by the workpiece geometry and operation sequence. Speed and feed of operations are determined using economic (total cost of machining) and technological (surface finish etc.) criteria from Machinability Data Systems. Two types of machinability data systems exist:

(i) Database Systems and

(ii) Mathematical Model Systems.

In the Database Systems, cutting conditions are recommended by accessing the database which contains the data from laboratory experiments and shop experience. Mathematical model systems predict the optimum cutting conditions taking cost minimization or production rate maximization as the objective.

2.2 TOOL PLANNING AND CONTROL (TPC):

The objective of Tool Planning and Control is to make the required tool of right type available on a machine on right time while keeping the total investment in tools at a

minimum. It also involves determining the tool procurement plan and the regrinding schedule for each tool. Fig. 2.1 gives a schematic presentation of Tool Planning and Control process. A detailed explanation of TPC is given below.

The process starts with the acquirement of product drawings and specifications from the Computer Aided Design (CAD) department. The next step is to carryout the tool type selection and machine tool type selection for the products depending on its configuration, specifications and the batch size.

Tool type selection involves selecting the type of tools to be used for the operations and is done based on the requirements of surface finish, type of operation and production rate. Batch size gives the number of jobs to be scheduled in a given time. This gives information about the required production rate. The machine tool type is selected based on the production rate, quality of the product and the machine tool capability.

The selection process is carried out by obtaining the information from Machine and Tool Databases. The tool database contains the information about the tool characteristics, tool life, number of regrindings that can be carried out, regrinding time and the cost of the tool. Machine database, on the other hand, consists of machine tool characteristics.

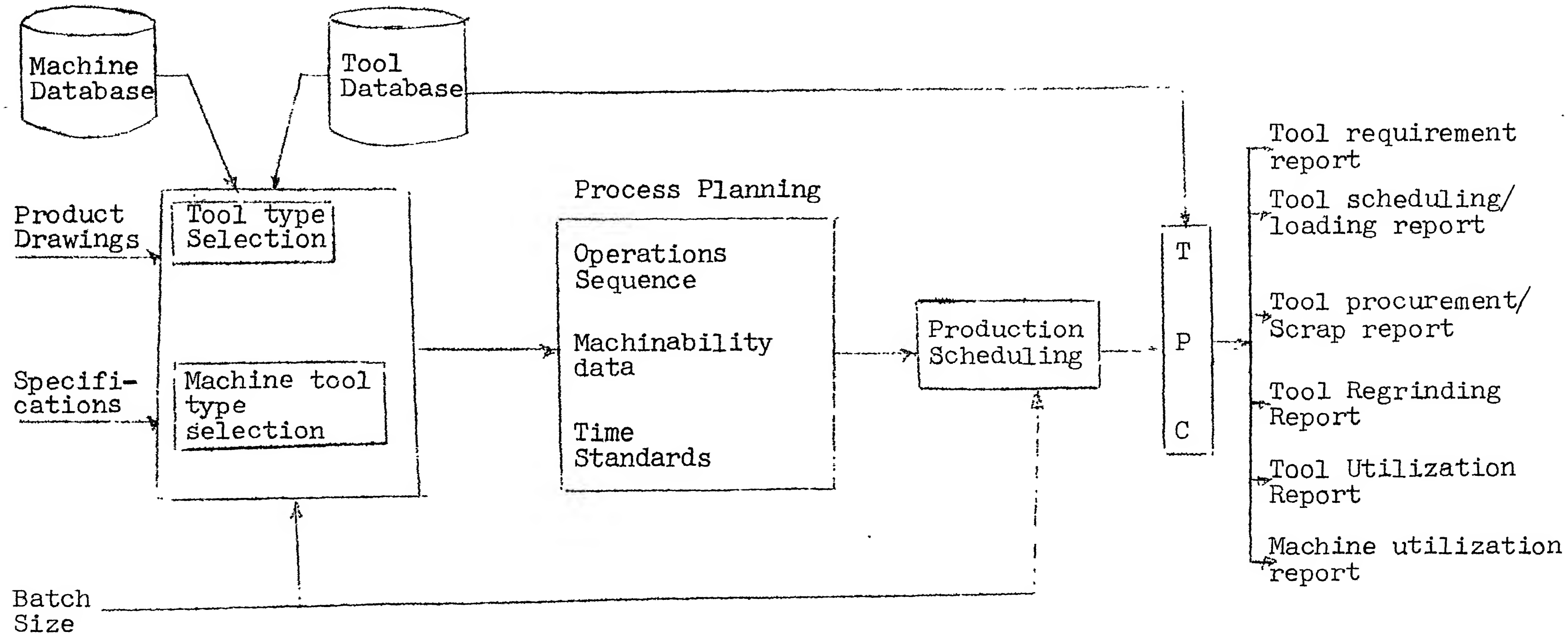

Fig. 2.1: Tool Management (Tool selection and tool planning and control).

The next step is to determine the sequence of operations. As explained earlier, in Sec. 1.2, process planning undertakes the task of determining the sequence of operations, cutting conditions and setting time standards.

Production schedule is prepared after performing process planning. A production schedule is a Gantt chart of machine/job sequence giving the start times and due dates for the operations. The inputs to production scheduling are Process Planning and batch size. Single tool may not be able to serve all the products in a batch because of its life constraint. A tool is sent for regrinding after its life is over and to undertake the remaining operations, a new tool of the same type is brought in. Batch size thus gives an idea of the requirement of the number of tools of the same type.

Tool Planning and Control function having the objectives mentioned before in this section, is carried out as the next step. The input to this is the Gantt Chart from production scheduling and information from Tool Database. To make the right type of tool available on machine at the right time, the tool life monitoring is to be done. Because the same tool may be used in different conditions and in different machines, evaluation of tool life becomes difficult. Wear criterion can be used to over come this. In this thesis

Flank wear criterion is used to evaluate the tool life and a detailed explanation of this is carried out in Sec. 3.4. The amount of wear caused at the flank for each operation depends on the time of operation and the cutting conditions. The flank wear occured is compared with the maximum allowable flank wear and the tools are sent for regrinding when the wear exceeds the limit. Tools having finished their maximum number of regrinding are scrapped and new tools are procured to replace them. The following outputs generated by TPC serve to meet its objectives.

(i) Tool Requirement Report:

The required number of tools of each type are given in this report. This helps in procuring the tools on time so that production is not interrupted.

(ii) Tool Scheduling Report:

It is a report indicating the operations and their sequence, each tool has to perform. This report being provided in advance helps in making available the right tools on the machines on right times.

(iii) Tool Procurement Report:

It is a report giving the schedule of tool procurement and consequently the schedule of tools to be scrapped. Stock control unit procures the tools according to the plan and maintains the tool stock.

(iv) Tool Regrinding Report:

A tool regrinding report informs the tool maintenance department about the schedule of tools to be sent for regrinding. The tool maintenance department thus can plan the regrinding facilities to meet the schedule.

(v) Tool and Machine Utilization Reports:

FMS being a capital intensive manufacturing system where huge amounts of capital is invested, the tool and machine utilization levels should be high to justify the investment. Tool and machine utilization reports provide the utilization levels of tools and machines respectively.

2.3 NEED FOR TOOL DATABASE:

To perform the functions of TPC described in the previous section, a computerised Tool Information System is necessary. This information system can be developed either by a conventional file organization system or by a Database Management System. The concepts and relative merits of the two systems are discussed below.

2.3.1 Conventional File Organization System:

In this system, the operational data may be kept in indexed, sequential or relative (hash coded) files. This method has two advantages. They are:

(i) Implementation is easy, and

(ii) Storage organization can be changed easily.

However, retrieval of operational data, based on primary and secondary keys becomes really difficult and requires too many files to be maintained. This leads to inconsistency in data and does not allow integrated processing. So, independent programs must use independent files. This reduces the flexibility and overall reliability dramatica and most of the real time requests are not satisfied.

2.3.2 Database Management Systems (DBMS):

Compared to conventional file organization systems, DBMS offers several advantages as given below:

(1) Provides logical as well as physical data independence,
(2) Offers ease in system design and programming,
(3) Provides for concurrent usage and multiple host languages,
(4) Offers effective system support and utilities are provided for controlling transactions and for user privacy and security of data,
(5) Provides a standard software interface for its users,
(6) Reduces data duplication to an economic level, which saves storage space and increases access speed,
(7) Integrity of the data can be maintained, and
(8) Standards can be enforced

Inview of the above advantages of DBMS, a Tool Databas is created for the Tool Information System. The position of

Tool Database in the overall system and its interaction with other subsystems is shown in Fig. 2.2 [6].

The sub-systems using the Tool Database include part programming, tool maintenance, stock control, production planning, process control and production scheduling.

2.4 SCOPE AND ORGANIZATION OF THE THESIS:

Systems Analysis is the starting block for the design of Tool Database. Chapter III is devoted for Systems Analysis where the functions, input considerations and the departments the organization who possibly may use TIS are considered.

Chapter IV discusses the strategy used for the database design and explains the salient features of the database designed.

The development and implementation aspects of the Tool Information System is dealt with in Chapter V.

In Chapter VI, conclusions are presented.

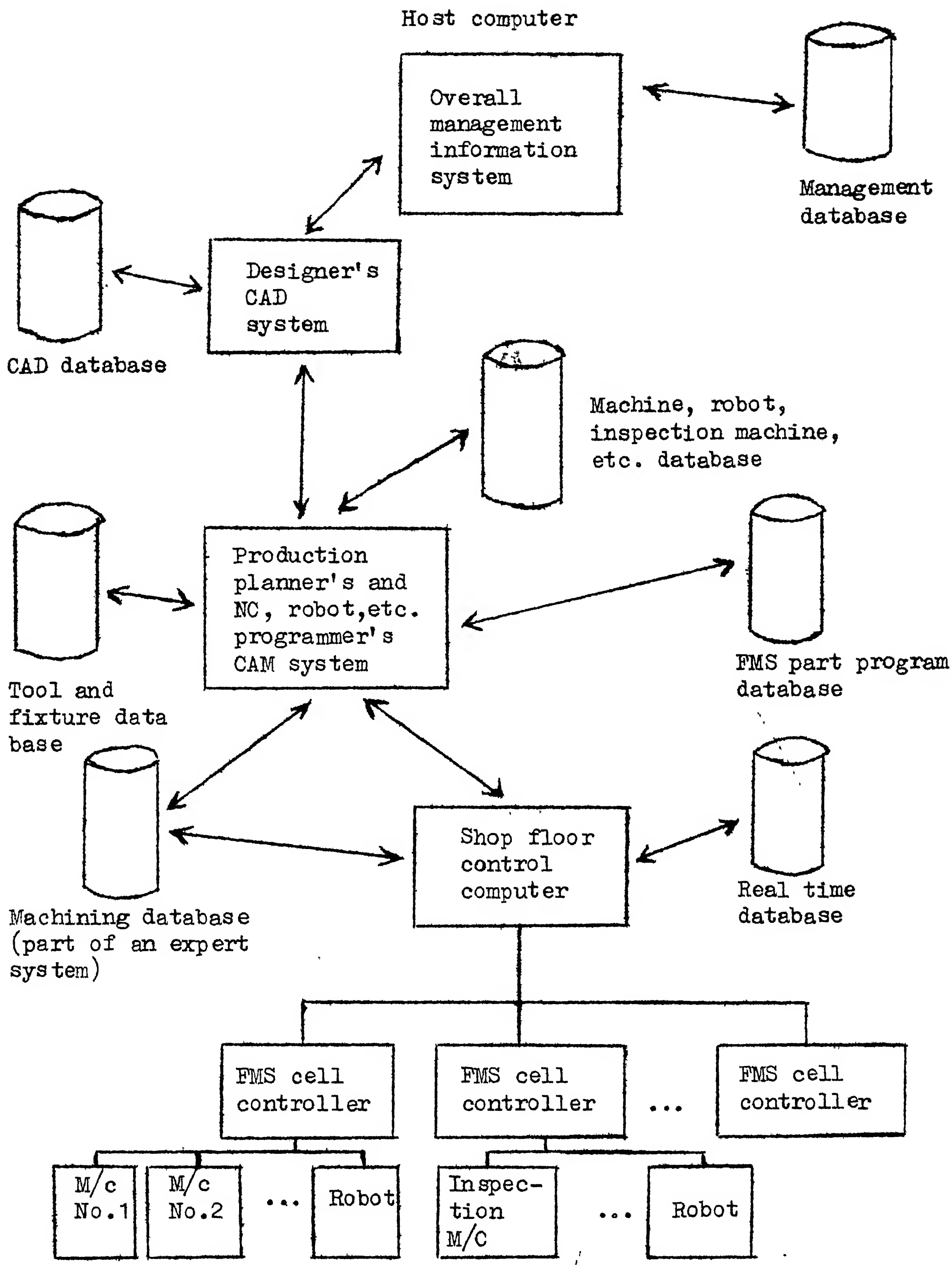

Fig. 2.2: Tool Database and its interaction with other subsyst

CHAPTER III

SYSTEMS ANALYSIS

Systems Analysis is undertaken to design the tool database for which a clear understanding of the environment and operation of the system is essential. The following text describes the environment and operation of FMS considered.

3.1 SYSTEM DESCRIPTION:

The Flexible Manufacturing System consists of a set of NC machine centres. The tools for all operations that can be performed by a machine are stored in its limited capacity tool magazine. Parts are mounted on pallets manually or by a robot at a loading station and are moved by the Automatic Material Handling System to the work stations, following a computer controlled route. Automatic Materials Handling Systems include Automated guided vehicles, conveyors, industrial robots and pallet transportation systems.

A central tool store serving all the machines is maintained. The tool interchanging time and the time for transportation of tools from one machine to another is assumed to be sequence independent and hence is merged in the operation time. If a required tool is not found on a machine, it is searched on the neighbouring machines. If not found on the

neighbouring machines, the tool is fetched from the central tool store.

A tool after rendering service till its life is sent for regrinding. It is assumed that the system has ample regrinding facilities and the tool need not wait for regrinding. The tool after regrinding is sent to the tool stock. A tool completing its maximum number of regrindings is scrapped.

3.2 USERS OF TOOL INFORMATION SYSTEM (TIS):

The following subsystems use the tool information system:

1. Production Planning
2. Process Control
3. Part Programming
4. Tool Maintenance
5. Stock Control, and
6. Process Planning

1. Production Planning: To generate a scheduling program, production planning system needs the information about the total availability of tools in stock and in the tool magazines of the machines.

2. Process Control: The process control system needs the latest information about tools to effectively control the system operations, and it updates any changes in real time.

3. Part Programming: For writing part programs, the actual sizes of tools and their behaviour in different cutting conditions is needed. The tool geometry is also used to check for the tool collision.

4. Tool Maintenance: Tool maintenance department needs the tool regrinding schedule to plan for the regrinding facilities.

5. Stock Control: Stock Control unit plans for the tool procurement after obtaining the tool procurement schedule.

6. Process Planning: It needs the information about tools to arrive at a sequence of manufacturing operations for the product.

3.3 FUNCTIONS OF TOOL INFORMATION SYSTEM:

To meet the above mentioned users requirements, the Tool Information System has to perform the following functions:

A tool scheduling report giving the operations and their sequence, each tool has to perform has to be provided. Prepare a tool procurement plan giving the schedule of tools to be procured. Provide a tool regrinding report, which indicates the schedule of tools to be sent for regrinding. A detailed description of these functions is given in Sec. 2.2. And finally, provide tool status information.

Tool Status Information:

Information about the size and geometry of tools is needed for part programming. Information about the availability

of tools in the system is needed for scheduling. The sequence of machining operations takes into account the information about tools.

To provide the above information, tool status reports giving the tool details are to be provided. Thus, a tool information system has to provide the following reports to meet the requirements.

(i) Status of a tool
(ii) Status of a set of tools
(iii) Status of a type of tools
(iv) Tools available on a machine
(v) Tools in stock
(vi) Tools of a material type

3.4 METHODOLOGIES FOR TOOL SELECTION AND TOOL LIFE:

The methodologies used for tool selection and tool life are given below:

3.4.1 Tool Selection:

Tools for the machining operations are usually selected based on the type of operation, work material, required surface finish, work piece geometry and size, required dimensions of the work piece etc. The cutting conditions for the tool namely the speed, feed and depth of cut are selected considering the tool and work piece material combination, surface

finish, work size, tool size, tool material characteristics, machine rigidity, coolant characteristics, tool geometry etc.

In the present thesis, tool selection is done based on the type of operation, surface finish and the required dimensions on the work piece.

3.4.2 Tool Life:

Tool life evaluation for the tools in operation in on FMS becomes difficult because the same tool may be used in different cutting conditions and on different machines. A solution to this problem is to employ wear criterion for the tool life evaluation. In the present thesis an analytical model is used for the tool wear phenomenon.

Tools usually fail by a process of gradual wear due to interaction between the chip and the tool, and between the work and the tool. After the tool has been in use for some time, wear land appears at the flank of the tool and also on the tool face forming a crater. The useful life of a tool is limited by the amount of tool wear.

Flank wear is the criterion used while machining brittle materials or when the feed is small. Both flank and crater wear take place when the feed is greater at low or moderate speeds. The crater wear effect on tool life is less when compared to flank wear in the usual cutting conditions. So, only flank wear criterion is used in the present thesis.

A quantitative term setting the limit of permissible value of wear is known as criterion of wear . The criterion of wear is dependent on cutting speed, feed and depth of cut. It is predominently dependent on cutting speed.

Flank wear, and time of operation bear a relation of the form [7],

$$h_f = C_1 T^{X_1}$$

where h_f = flank wear, T = time of operation and C_1 and X_1 are constants. C_1 depends on the work piece material and cutting conditions. X_1 depends on cutting conditions and it usually lies between 0.6 and 1.0.

3.5 INPUT CONSIDERATIONS:

The following input has to be provided to the Tool Information System to perform the above mentioned functions:

1. The job schedule giving the job and operation sequence on the machine along with the start and finish times,
2. The type of operation,
3. The surface finish required,
4. The tool material, and
5. The required dimensions of the product.

The criteria of tool selection and tool life should be also provided.

CHAPTER IV

DESIGN OF DATABASE

The design of tool database involves designing the dat structure and identifying data items to be included in each record type. It also involves deciding the DBMS features to be incorporated in the database. The strategy adopted for tool database design is given below.

4.1 DATA STRUCTURE DIAGRAM:

Data structure design is carried out using the data structure diagram, which provides a notation to detail entiti and their associations. Fig. 3.1 gives a schematic representation of the tool database using data structure diagram notations.

A rectangle enclosing a name denotes an entity or reco type that is used in the database. A directed arrow connects two record types. The record type located at the tail is called the owner and at the head is called the member. The arrow directed from owner to member is called a set-type.

The figure shows a number of set types where the owner is system. These are called singular sets and each imply an access path that passes through all occurrance of the member record type. These singular sets represent entry points into

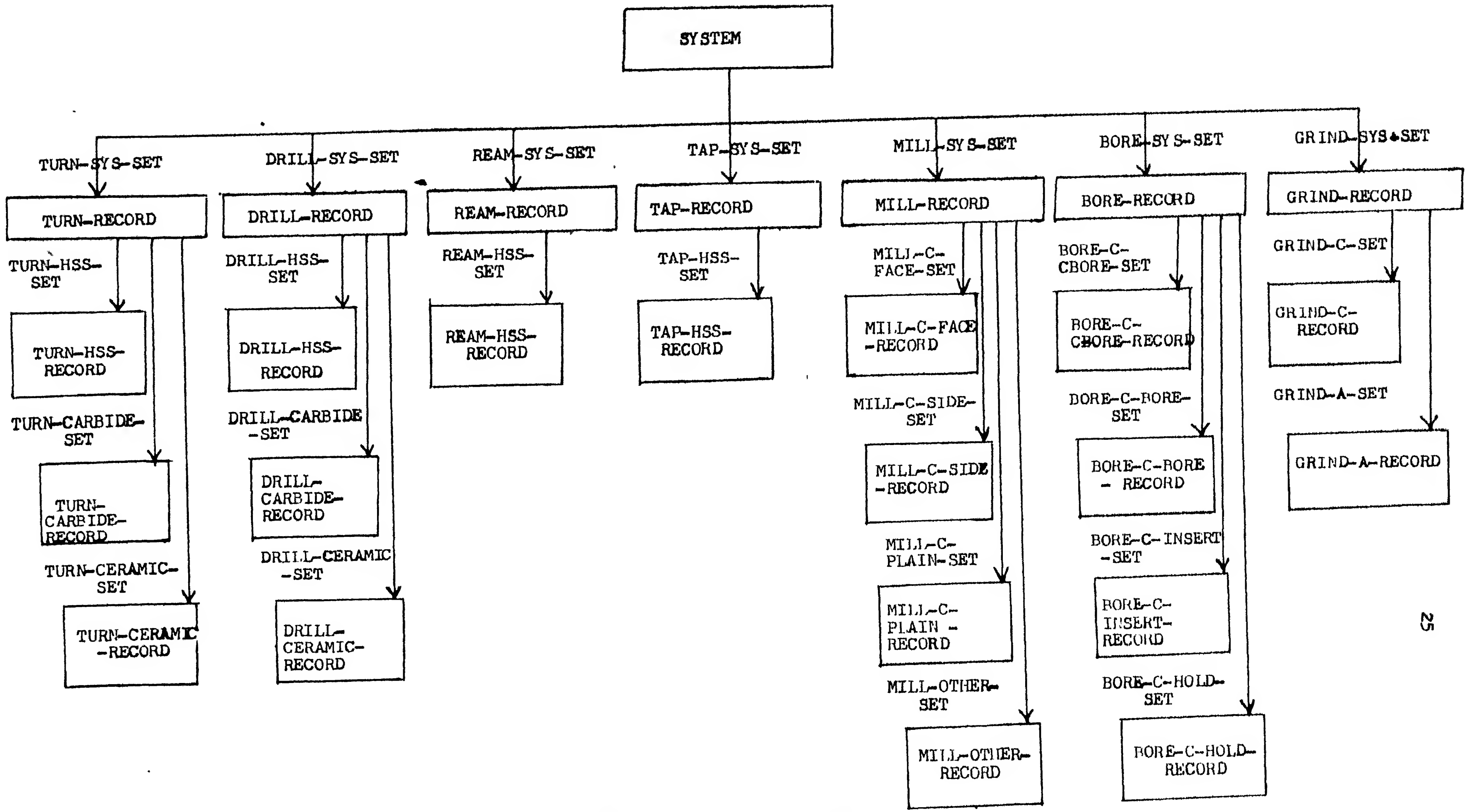

Fig. 4.1 DATA STRUCTURE DIAGRAM

the database in the sense that particular occurrances of the member records may be located by values of their constituent data items, with no need to have accessed other record types in the database.

4.2 DATA ITEMS:

The following data items are provided in each tool record type to provide the required information to different users of tool database. They are,

Tool number, Type of function (for example, a turning tool can be used to perform surface turning, facing or threading), Tool material, Tool fabrication type (solid, tipped or inserted), Type of operation (rough, semi-finish or finish), Feed type (left hand feed, right hand feed or any feed), Tool angles, Tool dimensions, Availability on a machine, Tool life, Time for regrinding, Remaining regrindings, Slots occupied by the tool in the tool magazine and Cost of the tool.

Additional data items required for certain record types are also provided depending on the requirement.

4.3 DESIGN OF TOOL DATABASE SCHEMA:

Knowledge of DBMS-10 package is required to understand the database schema. The salient features of DBMS-10 package are provided in Appendix A. Complete features of DBMS-10 can be had from [1] and [2]. In this section the data description (SCHEMA) of tool database is discussed and the SCHEMA listing is provided in Appendix B.

DMCL Environment Entry:

Back-up is done automatically and DBCS is requested to note only the unanticipated exceptions. This entry also specifies that the journal file is on disk and the name of journal file is BAKUP.JRN. Twenty five records are used per page.

DMCL Area Entries:

This specifies the physical storage details of the record occurrances in the specified areas. In DBMS-10, each area is assigned to a file (file name.DBS). The maximum number of records that can be stored on a page is the same as in Environment Entry. One CALC chain is put on a page. This need not be explicitly specified. The page range for a CALCED record type i.e. the record type whose location mode is CALC, must be odd because the way CALC algorithm works, the odd number will tend to cause a more even dispersion of the CALC record occurrances throughout the area.

DDL Schema and Area Entries:

The statement SCHEMA NAME IS TOOL names the schema. Area entry statements follow this. All areas are named in this and the privacy locks for exclusive update, kept for the opening of the areas are specified. The present schema definition will not allow simultaneous updates though it is possible in DBMS-10. The simultaneous updates are costlier and are used when the data is accessed by multiple users

simultaneously. The database is divided into seven areas namely TURN-AREA, DRILL-AREA, MILL-AREA, TAP-AREA, REAM-AREA, BORE-AREA and GRIND-AREA.

DDL Record Entries:

The tool database consists of twenty nine record types. Item description for various data items in each record type are self-explanatory. However, one record type (TURN-HSS-RECORD) is described as an example.

TURN-HSS-RECORD:

The first statement in this declaration names the record type. LOCATION MODE clause specifies the way in which record occurrances should be placed and retrieved. For this record type VIA clause is specified. This clause specifies that the record is accessed in a TURN-HSS-SET. The WITHIN clause specifies the area in which the record should be placed. The TURN-HSS-RECORD occurrances are placed in TURN-AREA. All data item descriptions are self explanatory.

DDL Set Entries:

The relationships between various record types, are described by means of sets. The simplest type of set description, known as singular set, is one in which the owner is implicitly the system. Since the system is unique owner, there can exist only one occurrance of such type. The main purpose of the sets is to access the occurrance of a particular record type in a particular sequence (i.e. sequential access).

There are in all twenty nine sets in the tool database. All these set descriptions follow the same format. TURN-HSS-SET .is described below as an example.

After naming the set type as TURN-HSS-SET, the mode of the set is defined as CHAIN LINKED TO PRIOR. This indicates the mechanism for the manipulation of record occurrances within the set. It indicates the way member-record occurrances in the set are linked together, as well as to the owner. In this set, each record is linked to the next record as well as to the prior record. The ORDER clause specifies the insertion point of a member record occurrance within set occurrance and there by defines the order of logical linkage. ORDER IS ALWAYS NEXT specifies that the current member record occurrance is always next to the existing ones. The OWNER is clause specifies the owner record type.

The MEMBER sub-entry names the member-record type. MEMBER is clause names the member of the set. This is followed by a clause specifying the way of removal of any record occurrance from that set occurrance and another clause specifying how the member record occurrances are initially placed in set occurrances. The MANDATORY specification indicates that once an occurrance of TURN-HSS-RECORD record is placed in TURN-HSS-SET set, it may not be removed from the set occurrance without actually deleting the record occurrance. The AUTOMATIC

specification specifies that each time a new occurrance of TURN-HSS-RECORD is stored in the database, it is automatically inserted into the TURN-HSS-SET set. The SET SELECTION clause allows the system to support AUTOMATIC insertion of member record occurrances into appropriate set occurrances. CURRENT OF SET dictates DBCS to select the current occurrance of the set type named in the set entry as the set occurrance into which the record occurrance must be inserted.

DDL Sub-Schema Entries:

A sub-schema description written in sub-schema DDL consists of sub-schema identification, AREA section, RECORD section and SET section.

Sub-schema identification entry names the sub-schema within a schema and also specifies a privacy lock for access to the sub-schema by run-units.

The AREA section specifies all the areas that are to be included in the sub-schema. The RECORD section defines the records of the schema that are to be included in the sub-schema. The SET section defines the sets of schema that are to be included in sub-schema.

CHAPTER V

DEVELOPMENT AND IMPLEMENTATION

To perform the functions of tool information system, programs are developed in COBOL and are implemented on DEC-1090 system at IIT Kanpur. The features of the programs developed are briefly discussed in the following text.

1. LOADING PROGRAM:

This program loads the data into the tool database. The flow chart is presented in Fig. 5.1.

The input to the program is the data to be loaded into the database. A description of tool database is given in Sec. 4.3. Checks are performed by the program to check the validity of the data. This ensures that only the valid records are entered and the invalid ones are rejected.

2. TOOL PLANNING PROGRAM:

Tool planning functions and tool selection are performed by this program. A description of tool planning functions and tool selection process has been made in Sec. 2.1 and 2.2. The criteria used for tool selection and tool life are discussed in Sec. 3.4. The flow diagram to the program is shown in Fig. 5.2.

Input to the program includes the job schedule along with the type of operation, surface finish requirement, tool material and required dimension of the product. The following output reports are generated:

(i) Tool scheduling report

(ii) Tool scrap/procurement report

(iii) Tool regrinding report

(iv) Tool utilization report, and

(v) Machine utilization report

3. TOOL INFORMATION PROGRAM:

Tool status information can be obtained from this program. Details about tool status information are given in Sec. 3.3. A good user interface is provided in this program. Because of the on-line and real time tool information requirements, the program is made user friendly and the information is displayed on the terminal. Fig. 5.3 gives the flow chart for this program. The following information about tools can be obtained from the program:

(a) Status of a tool

(b) Status of a set of tools

(c) Status of a type of tools

(d) Tools in stock

(e) Tools in regrinding

(f) Tools on a machine

4. UPDATE PROGRAM:

Any update to a tool record can be performed by this program. This is an interactive program, helping the user to carryout updating. The flow chart of this program is given in Fig. 5.4.

5. INSERT PROGRAM:

A new tool record can be inserted into the database using this program. As in loading program, checks are performed to check the validity of the data. The program is similar to the loading program and the flow chart is given in Fig.5.1.

Sample reports and listings generated by the above mentioned programs are given in Appendix C.

5.1 BACKUP STRATEGY AND RECOVERY OF DATABASE:

The backup and recovery procedures are important when recovering from catastrophic situations such as the loss of media, system failure, power failure or fatal human error. The packages in DBMS provide an alternative against such failures by allowing pre-image posting.

When an updating run-unit accesses the database, it has the potential of making damaging changes to the database. DBMS provides means to remove the changes made during the execution of a run unit. This is done by the use of journal

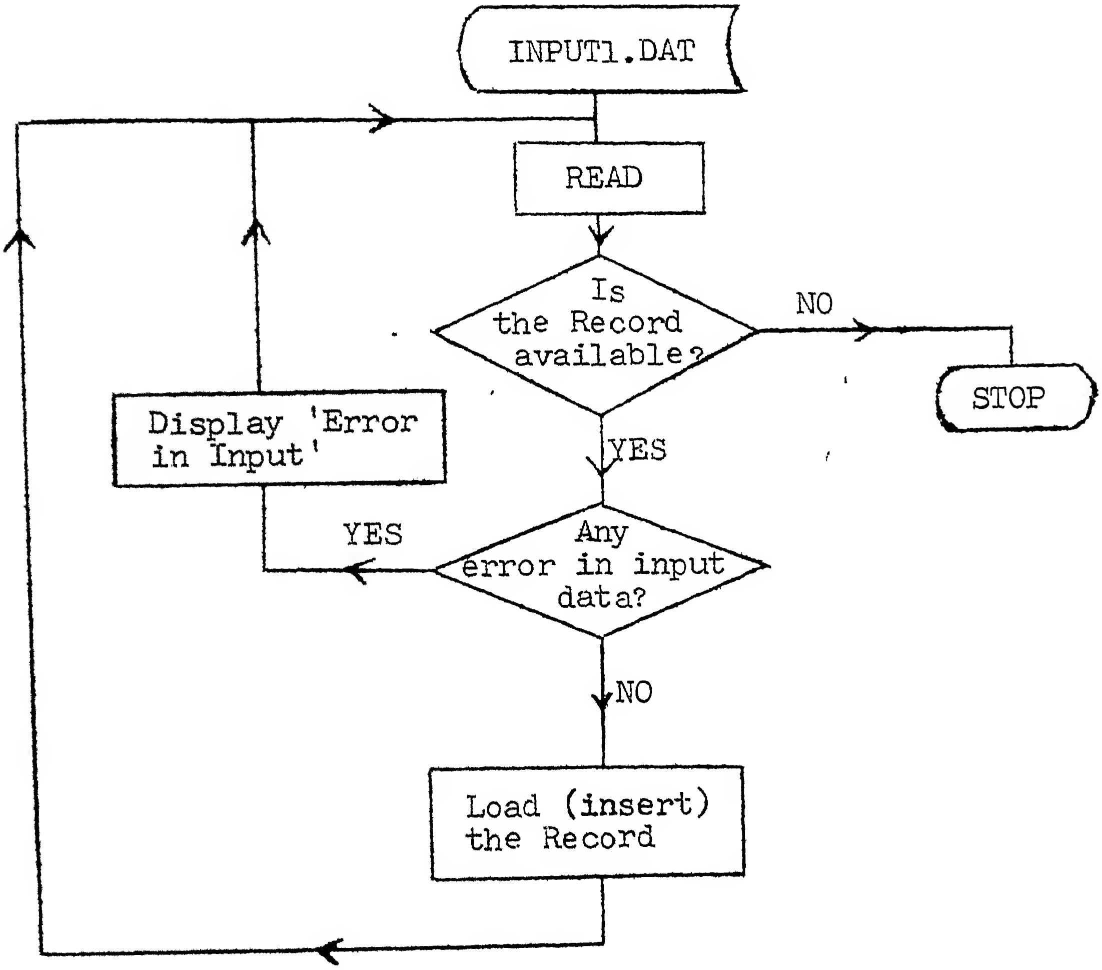

Fig. 5.1: Loading (Inserting) Program.

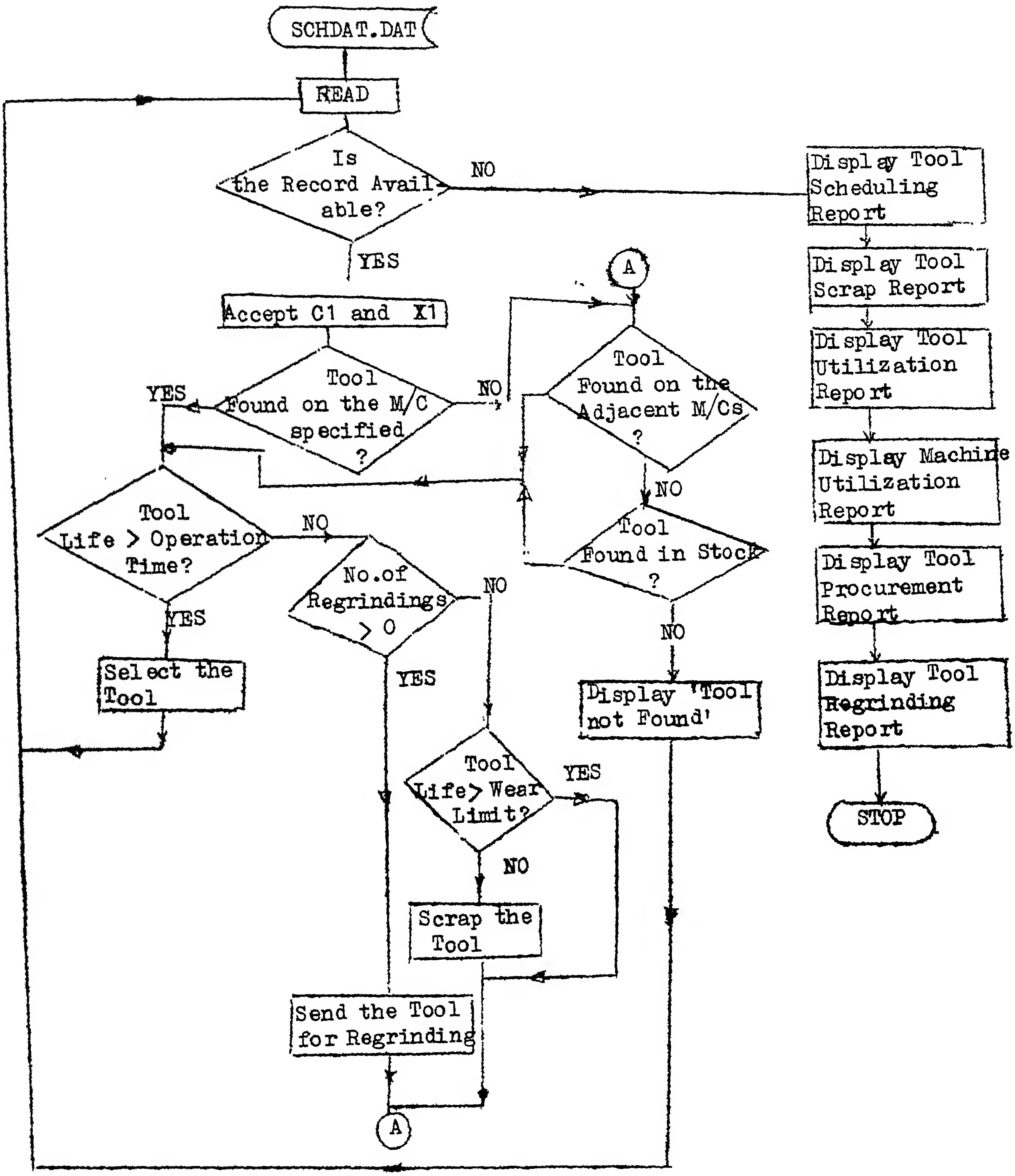

Fig. 5.2: Tool Planning Program.

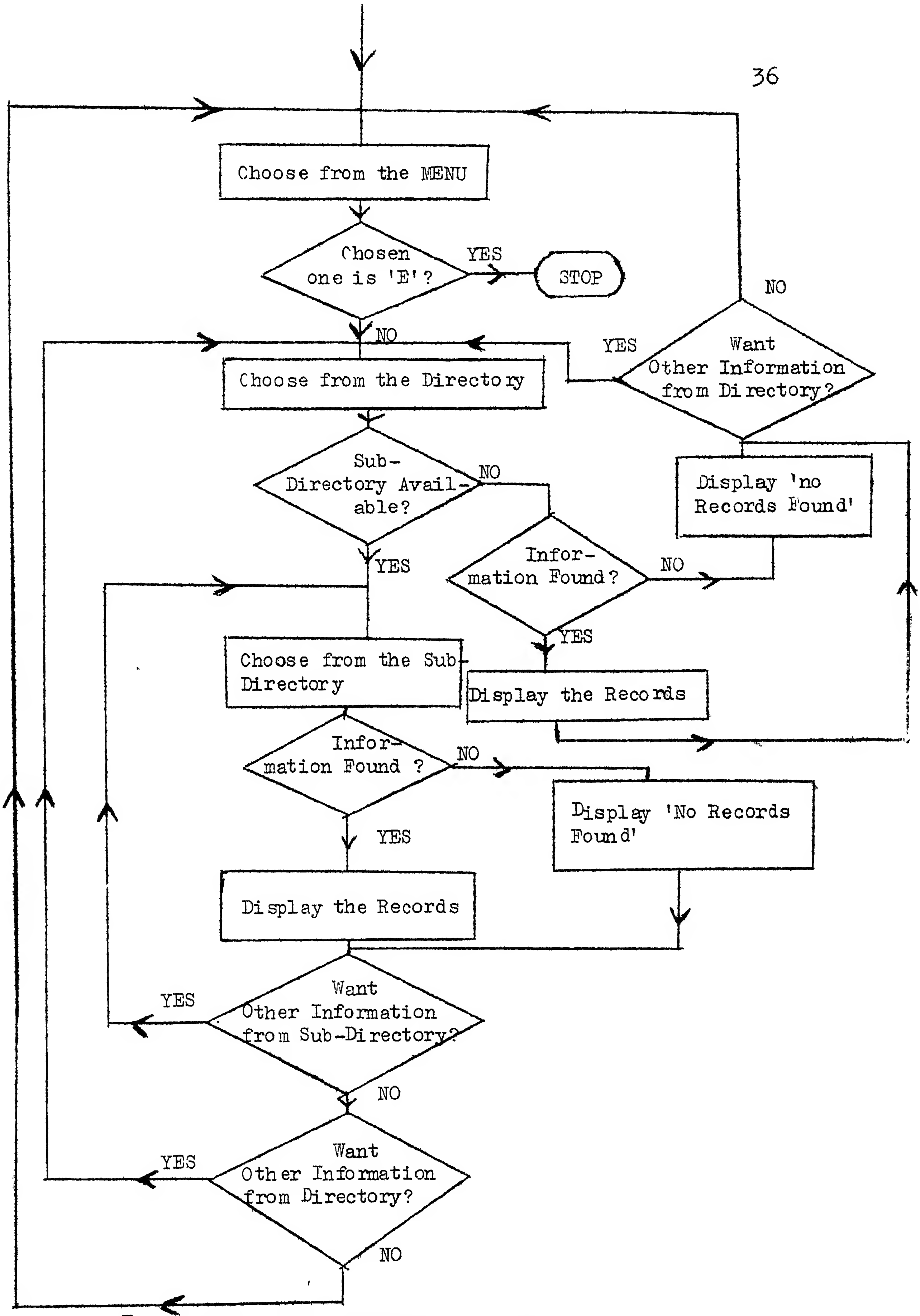

Fig. 5.3: Tool Information Program.

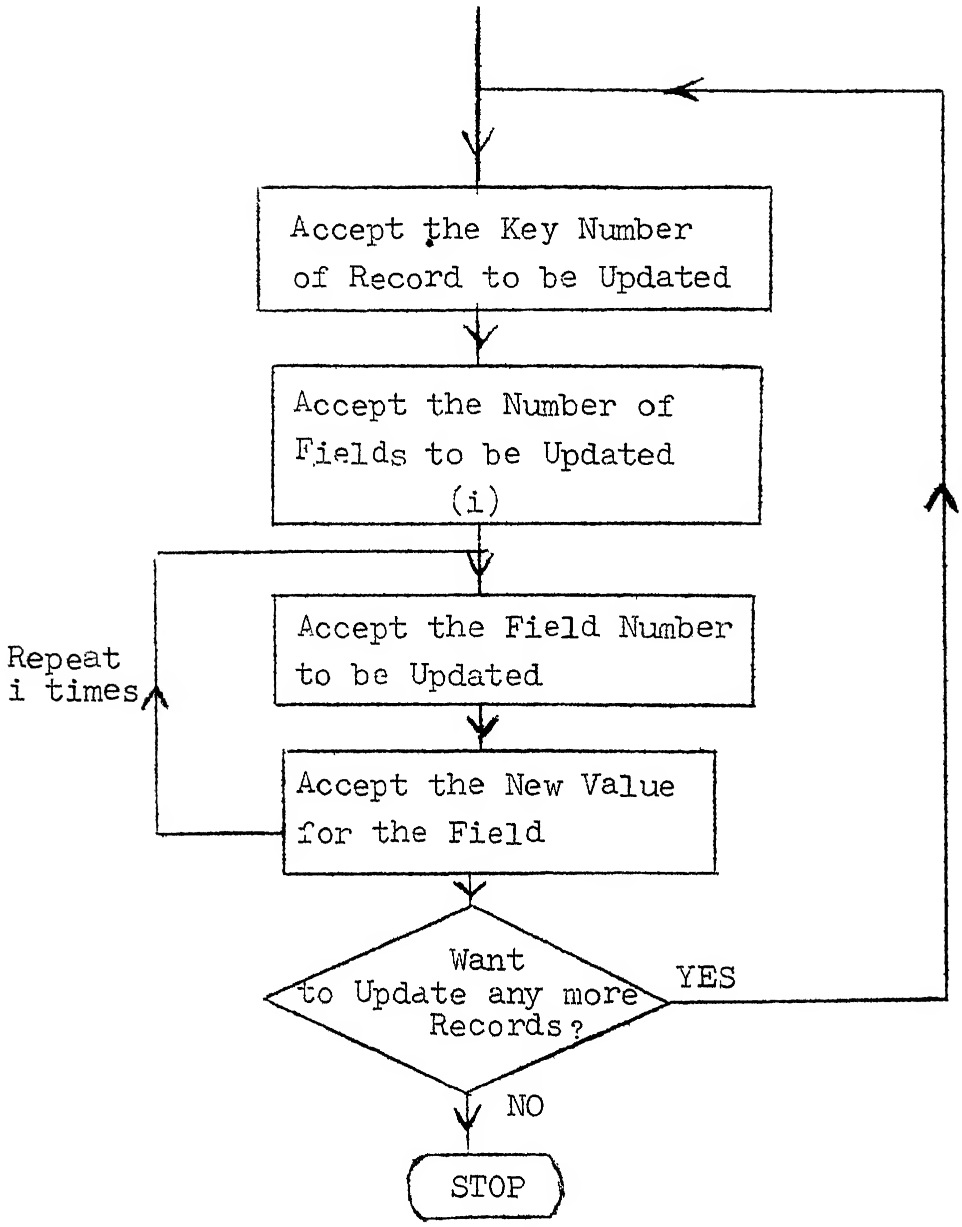

Fig. 5.4: Update Program.

file. Each time a run-unit updates a page in the database, DBCS writes a BEFORE image of that particular page in the journal file. A BEFORE image is a copy of a database page before the page is modified. For bringing back a old copy, an utility program called DBMEND is provided in the system.

CHAPTER VI

CONCLUDING REMARKS

A tool information system based on a database is developed for the use of various functions of manufacturing system, namely, 1) Part programming, 2) Production Planning, 3) Process Planning, 4) Process Control, 5) Tool Maintenance, and 6) Tool Stock Control.

Programs for initial loading, tool planning and control, tool information, updating and inserting are developed. Various reports like tool scheduling report, tool regrinding report, tool procurement report, tool utilization report and machine utilization reports are prepared.

For a given tool, a set of tools, or a type of tools the system provides the information about the status of tool(s) specifying whether in operation on a machine, lying idle on a machine, in stock or at the regrinding centre. It also provides the information with full details about all the tools available on a machine, in stock or at the regrinding centre.

For a given set of jobs with complete production schedule, the system generates the schedule for tocl loading, regrinding, procurement and scrap. The system provides the facility of updating the tool records also. A good user interface is provided in the system. The system is implemented on DEC-1090 Computer at IIT Kanpur.

The above mentioned outputs of the system can also be used for financial planning and control of investments in tools and their maintenance. As an extension, a complete tool selection process can be carried out by developing a separate database and integrating it with the tool database.

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APPENDIX A

DBMS-10 FEATURES

The DBMS package available on DEC System - 1090 is a group of programs that enable an installation to create, access, and maintain one or more data bases. It is based on 1971 CODASYL Data Base Task Group proposals.

A data base is a collection of inter-related data records structured and linked so that run-units can access them without regard to the physical storage medium.

Components of DBMS:

DBMS consists of the following programs and modules:

SCHEMA: The translator that processes the languages used to describe the data bases. It also allocates and initializes the storage space for the data base.

DBMEND: A utility program for back-up and recovery of portions of the data base.

DBINFO: A utility program that produces several reports such as cross reference listings and dumps of the database.

COBOL DBMS Module: The module of the COBOL Compiler that process database accessing statements.

DBCS: The object-time module of DBMS used with FORTRAN and COBOL object-time systems to access the database.

DATA DESCRIPTION OF DATABASE:

The data description of the database will be preceded by mapping of areas to one or more physical storage volumes using Device Media Control Language (DMCL). In the DMCL of DBMS-10, there are two types of entries.

i) DMCL Environment Entry:

This specifies the parameters that apply to the Schema as a whole e.g., the types of exceptions to be noted and the name of the journal file.

ii) DMCL Area Entry:

This assigns areas to files and specifies the physical characteristics of these files.

The data description of a database in the Schema Data Description Language (DDL) consists of five major sections.

i) An introductory clause
ii) One or more AREA clauses
iii) One or more RECORD clauses
iv) One or more SET clauses
v) One or more SUB-SCHEMA clauses

The introductory clause is used to name the database.

An AREA is a logical subdivision of the database, which corresponds to a file. While we think of a database as being a single integrated collection of data, it is often desirable

to subdivide such a data base into multiple logical sub units, in order to implement special security and integrity constraints and to control the performance and cost of implementation. The AREA description in the Schema DDL enables to name these subdivisions of the database and to keep LOCKS on these areas for different kinds of opening of these areas.

For every record type in a database, there exists a description in the Schema DDL. A Schema RECORD description consists of information about the record types such as its storage and location mechanism, and information about the area in which the record type may be placed. The RECORD description contains a description of all data items that constitute the record type. The occurrences of the record type are the units of data transfer between the stored data base and an application program. Thus, the application program interface uses a 'record at a time' logic (one record occurrence is delivered or stored for each command) in accessing the database.

For each set type in a database, a separate SET description is written in the Schema DDL. Each SET description names the set type, specifies the owner-record type and member-record type or types and states detailed information on how occurrences of the set are to be ordered and selected.

The Schema defines the entire database that is stored and available to all users. But an application program may

need to view only some parts of the database, as well as to make some simple changes. The sub-schema DDL allows a data base administrator to delimit the portions of a database (as described in the Schema) which are to be made available to the application programs. It also enables the database administrator to define logical record types (part of the record type only). The description of SUB-SCHEMA entry has four sections namely, SUB-SCHEMA entry, AREA section, RECORD section and SET section.

```
*
*
IMAGES BY COMMAND.
NOTE UNANTICIPATED EXCEPTIONS.
JOURNAL IS BAKUP.
RECORDS-PER-PAGE IS 10.

ASSIGN TURN-AREA TO TURN
BACKUP BEFORE IMAGES
FIRST PAGE IS 1
LAST PAGE IS 11
PAGE SIZE IS 256 WORDS.

ASSIGN DRILL-AREA TO DRILL
BACKUP BEFORE IMAGES
FIRST PAGE IS 15
LAST PAGE IS 25
PAGE SIZE IS 256 WORDS.

ASSIGN MILL-AREA TO MILL
BACKUP BEFORE IMAGES
FIRST PAGE IS 30
LAST PAGE IS 40
PAGE SIZE IS 256 WORDS.

ASSIGN TAP-AREA TO TAP
BACKUP BEFORE IMAGES
FIRST PAGE IS 45
LAST PAGE IS 55
PAGE SIZE IS 256 WORDS.

ASSIGN REAM-AREA TO REAM
BACKUP BEFORE IMAGES
FIRST PAGE IS 60
LAST PAGE IS 70
PAGE SIZE IS 256 WORDS.

ASSIGN BORE-AREA TO BORE
BACKUP BEFORE IMAGES
FIPST PAGE IS 75
LAST PAGE IS 85
PAGE SIZE IS 256 WORDS.

ASSIGN GRIND-AREA TO GRIND
```



```
BACKUP BEFORE IMAGES
FIRST PAGE IS 90
LAST PAGE IS 100
PAGE SIZE IS 256 WORDS.

SCHEMA NAME IS TOOL.

AREA NAME IS TURN-AREA
        PRIVACY LOCK FOR EXCLUSIVE UPDATE IS TKEY.

AREA NAME IS DRILL-AREA
        PRIVACY LOCK FOR EXCLUSIVE UPDATE IS DKEY.
```

```
         PRIVACY LOCK FOR EXCLUSIVE UPDATE IS BKEY.
AREA NAME IS MILL-AREA.
         PRIVACY LOCK FOR EXCLUSIVE UPDATE IS MKEY.
AREA NAME IS TAP-AREA.
         PRIVACY LOCK FOR EXCLUSIVE UPDATE IS TAKEY.
AREA NAME IS REAM-AREA.
         PRIVACY LOCK FOR EXCLUSIVE UPDATE IS RKEY.
AREA NAME IS GRIND-AREA.
         PRIVACY LOCK FOR EXCLUSIVE UPDATE IS GKEY.
RECORD NAME IS TURN-RECORD
         LOCATION MODE IS CALC USING TTOOL-TYPE
         WITHIN TURN-AREA.

         02        TTOOL-TYPE         PIC X(10).
RECORD NAME IS DRILL-RECORD
         LOCATION MODE IS CALC USING DTOOL-TYPE
         WITHIN DRILL-AREA.

         02        DTOOL-TYPE         PIC X(10).
RECORD NAME IS BORE-RECORD
         LOCATION MODE IS CALC USING BTOOL-TYPE
         WITHIN BORE-AREA.

         02        BTOOL-TYPE         PIC X(10).
```



```
RECORD NAME IS MILL-RECORD
         LOCATION MODE IS CALC USING MTOOL-TYPE
         WITHIN MILL-AREA.

         02        MTOOL-TYPE         PIC X(10).
RECORD NAME IS REAM-RECORD
         LOCATION MODE IS CALC USING RTOOL-TYPE
         WITHIN REAM-AREA.

         02        RTOOL-TYPE         PIC X(10).
RECORD NAME IS TAP-RECORD
         LOCATION MODE IS CALC USING TATOOL-TYPE
         WITHIN TAP-AREA.

         02        TATOOL-TYPE        PIC X(10).
RECORD NAME IS GRIND-RECORD
         LOCATION MODE IS CALC USING GTOOL-TYPE
         WITHIN GRIND-AREA.

         02        GTOOL-TYPE         PIC X(10).
RECORD NAME IS TURN-HSS-RECORD
         LOCATION MODE IS VIA TURN-HSS-SET
         WITHIN TURN-AREA.

         02        TH-TOOL-NO               PIC 9(6).
         02        TH-TOOL-MATERIAL         PIC X(10)
         02        TH-TOOL-TYPE             PIC X(1).
```

```
          02          TH-FEED-TYPE                PIC X(2).
          02          TH-NO-OPERATION             PIC X(10).
          02          TH-FRONT-RAKE               PIC 999V99.
          02          TH-SIDE-RAKE                PIC 999V99.
          02          TH-FRONT-CLEARENCE          PIC 999V99.
          02          TH-SIDE-CLEARENCE           PIC 999V99.
          02          TH-END-CUTTING              PIC 999V99.
          02          TH-SIDE-CUTTING             PIC 999V99.
          02          TH-TOOL-LENGTH              PIC 999V99.
          02          TH-SHANK-WIDTH              PIC 999V99.
          02          TH-SHANK-BREADTH            PIC 999V99.
          02          TH-NOSE-RADIUS              PIC 999V99.
          02          TH-SIZE-TYPE                PIC X(2).
          02          TH-AVAILABLE-ON-MC          PIC 99.
          02          TH-TOOL-LIFE                PIC 9V9999.
```



```
          02          TH-GRIND-TIME               PIC 999.
          02          TH-NO-OF-GRINDINGS          PIC 99.
          02          TH-TOOLSLOT-NO              PIC 9.
          02          TH-TOOL-COST                PIC 9(4).
          02          TH-MISCELANEOUS             PIC X(20).

RECORD NAME IS TURN-CERAMIC-RECORD
       LOCATION MODE IS VIA TURN-CERAMIC-SET
       WITHIN TURN-AREA.

          02          TCER-TOOL-NO                PIC 9(6).
          02          TCER-TOOL-MATERIAL          PIC X(10).
          02          TCER-TOOL-TYPE              PIC X(1).
          02          TCER-TYPE-OPERATION         PIC X(2).
          02          TCER-FEED-TYPE              PIC X(2).
          02          TCER-NO-OPERATION                PIC X(10).
          02          TCER-FRONT-RAKE             PIC 999V99.
          02          TCER-SIDE-RAKE              PIC 999V99.
          02          TCER-FRONT-CLEARENCE        PIC 999V99.
          02          TCER-SIDE-CLEARENCE         PIC 999V99.
          02          TCER-END-CUTTING                      PIC 999V99.
          02          TCER-SIDE-CUTTING                     PIC 999V99.
          02          TCER-TOOL-LENGTH                      PIC 999V99.
          02          TCER-SHANK-WIDTH                      PIC 999V99.
          02          TCER-SHANK-BREADTH          PIC 999V99.
          02          TCER-NOSE-RADIUS                      PIC 999V99.
          02          TCER-SIZE-TYPE              PIC X(2).
          02          TCER-AVAILABLE-ON-MC        PIC 99.
          02          TCER-TOOL-LIFE              PIC 9V9999.
          02          TCER-GRIND-TIME             PIC 999.
          02          TCER-NO-OF-GRINDINGS        PIC 99.
          02          TCER-TOOLSLOT-NO                 PIC 9.
          02          TCER-TOOL-COST              PIC 9(4).
          02          TCER-MISCELANEOUS                PIC X(20).

RECORD NAME IS TURN-CARBIDE-RECORD
       LOCATION MODE IS VIA TURN-CARBIDE-SET
       WITHIN TURN-AREA.

          02          TCAR-TOOL-NO                PIC 9(6).
          02          TCAR-TOOL-MATERIAL          PIC X(10).
          02          TCAR-TOOL-TYPE              PIC X(1).
          02          TCAR-TYPE-OPERATION         PIC X(2).
          02          TCAR-FEED-TYPE              PIC X(2).
          02          TCAR-NO-OPERATION                PIC X(10).
```

```
        02      TCAR-FRONT-RAKE            PIC 999V99.
        02      TCAR-SIDE-RAKE             PIC 999V99.
        02      TCAR-FRONT-CLEARENCE       PIC 999V99.
        02      TCAR-SIDE-CLEARENCE        PIC 999V99.
        02      TCAR-END-CUTTING                 PIC 999V99.
        02      TCAR-SIDE-CUTTING                PIC 999V99.
        02      TCAR-TOOL-LENGTH                 PIC 999V99.
        02      TCAR-SHANK-WIDTH                 PIC 999V99.
        02      TCAR-SHANK-BREADTH         PIC 999V99.
        02      TCAR-NOSE-RADIUS                 PIC 999V99.
        02      TCAR-SIZE-TYPE             PIC X(2).
        02      TCAR-AVAILABLE-ON-MC       PIC 99.
        02      TCAR-TOOL-LIFE             PIC 9V9999.
        02      TCAR-GRIND-TIME            PIC 999.
        02      TCAR-NO-OF-GRINDINGS       PIC 99.
        02      TCAR-TOOLSLOT-NO                 PIC 9.
        02      TCAR-TOOL-COST             PIC 9(4).
        02      TCAR-MISCELANEOUS                PIC X(20).
RECORD NAME IS TAP-HSS-RECORD
        LOCATION MODE IS VIA TAP-HSS-SET
        WITHIN TAP-AREA.

        02      TAH-TOOL-NO                PIC 9(6).
        02      TAH-TOOL-MATERIAL          PIC X(10).
        02      TAH-TOOL-OPERATION         PIC X(2).
        02      TAH-FEED-TYPE              PIC X(2).
        02      TAH-CHAMFER       PIC 999V99.
        02      TAH-FLANK         PIC 999V99.
        02      TAH-FLUTE-HELIX   PIC 999V99.
        02      TAH-RADIAL-RAKE   PIC 999V99.
        02      TAH-RELIEF        PIC 999V99.
        02      TAH-MAJOR-DIA     PIC 999V99.
        02      TAH-MINOR-DIA     PIC 999V99.
        02      TAH-TOTAL-LENGTH           PIC 999V99.
        02      TAH-PITCH-DIA     PIC 999V99.
        02      TAH-PITCH                  PIC 999V99.
        02      TAH-THREAD-LENGTH          PIC 999V99.
        02      TAH-BACK-TAPER    PIC 999V99.
        02      TAH-SIZE-TYPE       PIC X(2).
        02      TAH-AVAILABLE-ON-MC        PIC 99.
        02      TAH-TOOL-LIFE              PIC 9V9999.
        02      TAH-GRIND-TIME             PIC 999.
        02      TAH-NO-OF-GRINDINGS        PIC 99.
        02      TAH-TOOLSLOT-NO            PIC 9.
        02      TAH-TOOL-COST              PIC 9(4).
        02      TAH-MISCELLANEOS           PIC X(20).
```

```
RECORD NAME IS TAP-CERAMIC-RECORD
       LOCATION MODE IS VIA TAP-CERAMIC-SET
       WITHIN TAP-AREA.

       02        TACER-TOOL-NO                PIC 9(6).
       02        TACER-TOOL-MATERIAL          PIC X(10).
       02        TACER-TOOL-OPERATION         PIC X(2).
       02        TACER-FEED-TYPE              PIC X(2).
       02        TACER-CHAMFER      PIC 999V99.
       02        TACER-FLANK        PIC 999V99.
       02        TACER-FLUTE-HELIX            PIC 999V99.
       02        TACER-RADIAL-RAKE            PIC 999V99.
       02        TACER-RELIEF       PIC 999V99.
       02        TACER-MAJOR-DIA PIC 999V99.
       02        TACER-MINOR-DIA PIC 999V99.
       02        TACER-TOTAL-LENGTH           PIC 999V99.
       02        TACER-PITCH-DIA PIC 999V99.
       02        TACER-PITCH                  PIC 999V99.
       02        TACER-THREAD-LENGTH          PIC 999V99.
       02        TACER-BACK-TAPER             PIC 999V99.
       02        TACER-SIZE-TYPE               PIC X(2).
       02        TACER-AVAILABLE-ON-MC        PIC 99.
       02        TACER-TOOL-LIFE              PIC 9V9999.
       02        TACER-GRIND-TIME                   PIC 999.
       02        TACER-NO-OF-GRINDINGS        PIC 99.
       02        TACER-TOOLSLOT-NO                  PIC 9.
       02        TACER-TOOL-COST              PIC 9(4).
       02        TACER-MISCELLANEOS           PIC X(20).
RECORD NAME IS TAP-CARBIDE-RECORD
       LOCATION MODE IS VIA TAP-CARBIDE-SET
       WITHIN TAP-AREA.

       02        TACAR-TOOL-NO                PIC 9(6).
       02        TACAR-TOOL-MATERIAL          PIC X(10).
       02        TACAR-TOOL-OPERATION         PIC X(2).
       02        TACAR-FEED-TYPE              PIC X(2).
       02        TACAR-CHAMFER      PIC 999V99.
       02        TACAR-FLANK        PIC 999V99.
       02        TACAR-FLUTE-HELIX            PIC 999V99.
       02        TACAR-RADIAL-RAKE            PIC 999V99.
       02        TACAR-RELIEF       PIC 999V99.
       02        TACAR-MAJOR-DIA PIC 999V99.
       02        TACAR-MINOR-DIA PIC 999V99.
       02        TACAR-TOTAL-LENGTH           PIC 999V99.
       02        TACAR-PITCH-DIA PIC 999V99.
```



```
       02        TACAR-PITCH                  PIC 999V99.
       02        TACAR-THREAD-LENGTH          PIC 999V99.
       02        TACAR-BACK-TAPER             PIC 999V99.
       02        TACAR-SIZE-TYPE               PIC X(2).
       02        TACAR-AVAILABLE-ON-MC        PIC 99.
       02        TACAR-TOOL-LIFE              PIC 9V9999.
       02        TACAR-GRIND-TIME                   PIC 999.
       02        TACAR-NO-OF-GRINDINGS        PIC 99.
       02        TACAR-TOOLSLOT-NO                  PIC 9.
       02        TACAR-TOOL-COST              PIC 9(4).
       02        TACAR-MISCELLANEOS           PIC X(20).
```

```
RECORD NAME IS REAM-HSS-RECORD
       LOCATION MODE IS VIA REAM-HSS-SET
       WITHIN REAM-AREA.

       02          RH-TOOL-NO                    PIC 9(6).
       02          RH-TOOL-MATERIAL              PIC X(10).
       02          RH-FEED-TYPE                  PIC X(2).
       02          RH-RAKE PIC 999V99.
       02          RH-HELIX              PIC 999V99.
       02          RH-PRIM-CLEARENCE             PIC 999V99.
       02          RH-SEC-CLEARENCE              PIC 999V99.
       02          RH-TAPER-LEAD    PIC 999V99.
       02          RH-BEVEL-LEAD    PIC 999V99.
       02          RH-DIAMETER      PIC 999V99.
       02          RH-TOTAL-LENGTH  PIC 999V99.
       02          RH-CUTTING-LENGTH             PIC 999V99.
       02          RH-BACK-TAPER    PIC 999V99.
       02          RH-AVAILABLE-ON-MC            PIC 99.
       02          RH-TOOL-LIFE                  PIC 9V9999.
       02          RH-GRIND-TIME                 PIC 999.
       02          RH-NO-OF-GRINDINGS            PIC 99.
       02          RH-TOOLSLOT-NO                PIC 9.
       02          RH-TOOL-COST                  PIC 9(4).
       02          RH-MISCELANEOUS               PIC X(20).

RECORD NAME IS REAM-CARBIDE-RECORD
       LOCATION MODE IS VIA REAM-CARBIDE-SET
       WITHIN REAM-AREA.

       02          RCAR-TOOL-NO                  PIC 9(6).
       02          RCAR-TOOL-MATERIAL            PIC X(10).
       02          RCAR-FEED-TYPE                PIC X(2).
       02          RCAR-RAKE          PIC 999V99.
       02          RCAR-HELIX         PIC 999V99.
       02          RCAR-PRIM-CLEARENCE           PIC 999V99.
```



```
       02          RCAR-SEC-CLEARENCE            PIC 999V99.
       02          RCAR-TAPER-LEAD PIC 999V99.
       02          RCAR-BEVEL-LEAD PIC 999V99.
       02          RCAR-DIAMETER   PIC 999V99.
       02          RCAR-TOTAL-LENGTH             PIC 999V99.
       02          RCAR-CUTTING-LENGTH           PIC 999V99.
       02          RCAR-BACK-TAPER PIC 999V99.
       02          RCAR-AVAILABLE-ON-MC          PIC 99.
       02          RCAR-TOOL-LIFE                PIC 9V9999.
       02          RCAR-GRIND-TIME               PIC 999.
       02          RCAR-NO-OF-GRINDINGS          PIC 99.
       02          RCAR-TOOLSLOT-NO                 PIC 9.
       02          RCAR-TOOL-COST                PIC 9(4).
       02          RCAR-MISCELANEOUS                PIC X(20).

RECORD NAME IS REAM-CERAMIC-RECORD
       LOCATION MODE IS VIA REAM-CERAMIC-SET
       WITHIN REAM-AREA.

       02          RCER-TOOL-NO                  PIC 9(6).
       02          RCER-TOOL-MATERIAL            PIC X(10).
       02          RCER-FEED-TYPE                PIC X(2).
       02          RCER-RAKE          PIC 999V99.
       02          RCER-HELIX         PIC 999V99.
       02          RCER-PRIM-CLEARENCE           PIC 999V99.
       02          RCER-SEC-CLEARENCE            PIC 999V99.
       02          RCER-TAPER-LEAD PIC 999V99.
       02          RCER-BEVEL-LEAD PIC 999V99.
```

```
02          RMER-DIAMETER    PIC 999V99.
02          RMER-TOTAL-LENGTH           PIC 999V99.
02          RMER-CUTTING-LENGTH         PIC 999V99.
02          RMER-BACK-TAPER PIC 999V99.
02          RMER-AVAILABLE-ON-MC        PIC 99.
02          RMER-TOOL-LIFE              PIC 9V9999.
02          RMER-GRIND-TIME             PIC 999.
02          RMER-NO-OF-GRINDINGS        PIC 99.
02          RMER-TOOLSLOT-NO                PIC 9.
02          RMER-TOOL-COST              PIC 9(4).
02          RMER-MISCELANEOUS                PIC X(20).

RECORD NAME IS GRIND-C-RECORD
       LOCATION MODE IS VIA GRIND-C-SET
       WITHIN GRIND-AREA.

02          GC-TOOL-NO                  PIC 9(6).
02          GC-TOOL-MATERIAL            PIC X(10).
02          GC-TYPE-OPERATION           PIC X(2).
```



```
02          GC-WHEEL-DIA      PIC 999V99.
02          GC-WHEEL-WIDTH    PIC 999V99.
02          GC-SIZE-TYPE      PIC X(2).
02          GC-AVAILABLE-ON-MC          PIC 99.
02          GC-TOOL-LIFE                PIC 9V9999.
02          GC-GRIND-TIME               PIC 999.
02          GC-NO-OF-GRINDINGS          PIC 99.
02          GC-TOOLSLOT-NO              PIC 9.
02          GC-TOOL-COST                PIC 9(4).
02          GC-MISCELANEOUS             PIC X(20).

RECORD NAME IS GRIND-A-RECORD
       LOCATION MODE IS VIA GRIND-A-SET
       WITHIN GRIND-AREA.

02          GA-TOOL-NO                  PIC 9(6).
02          GA-TOOL-MATERIAL            PIC X(10).
02          GA-TYPE-OPERATION           PIC X(2).
02          GA-WHEEL-DIA      PIC 999V99.
02          GA-WHEEL-WIDTH    PIC 999V99.
02          GA-SIZE-TYPE      PIC X(2).
02          GA-AVAILABLE-ON-MC          PIC 99.
02          GA-TOOL-LIFE                PIC 9V9999.
02          GA-GRIND-TIME               PIC 999.
02          GA-NO-OF-GRINDINGS          PIC 99.
02          GA-TOOLSLOT-NO              PIC 9.
02          GA-TOOL-COST                PIC 9(4).
02          GA-MISCELANEOUS             PIC X(20).

RECORD NAME IS DRILL-HSS-RECORD
       LOCATION MODE IS VIA DRILL-HSS-SET
       WITHIN DRILL-AREA.

02          DH-TOOL-NO                  PIC 9(6).
02          DH-TOOL-MATERIAL            PIC X(10).
02          DH-TOOL-TYPE      PIC X(1).
02          DH-HARDNESS       PIC X(1).
02          DH-HOLDER-DETAILS             PIC X(30).
02          DH-POINT          PIC 999V99.
02          DH-HELIX-RAKE     PIC 999V99.
02          DH-LIP-CLEARENCE              PIC 999V99.
02          DH-CHISEL-EDGE    PIC 999V99.
02          DH-DIAMETER       PIC 999V99.
02          DH-TOTAL-LENGTH   PIC 999V99.
```

```
02      DH-BACK-TAPER   PIC X(10).
02      DH-SIZE-TYPE    PIC X(2).
```



```
02      DH-AVAILABLE-ON-MC          PIC 99.
02      DH-TOOL-LIFE                PIC 9V9999.
02      DH-GRIND-TIME               PIC 999.
02      DH-NO-OF-GRINDINGS          PIC 99.
02      DH-TOOLSLOT-NO              PIC 9.
02      DH-TOOL-COST                PIC 9(4).
02      DH-MISCELANEOUS             PIC X(20).
RECORD NAME IS DRILL-CARBIDE-RECORD
        LOCATION MODE IS VIA DRILL-CARBIDE-SET
        WITHIN DRILL-AREA.
02      DCAR-TOOL-NO                PIC 9(6).
02      DCAR-TOOL-MATERIAL          PIC X(10).
02      DCAR-TOOL-TYPE   PIC X(1).
02      DCAR-HARDNESS    PIC X(1).
02      DCAR-HOLDER-DETAILS         PIC X(10).
02      DCAR-POINT       PIC 999V99.
02      DCAR-HELIX-RAKE             PIC 999V99.
02      DCAR-LIP-CLEARENCE          PIC 999V99.
02      DCAR-CHISEL-EDGE            PIC 999V99.
02      DCAR-DIAMETER    PIC 999V99.
02      DCAR-TOTAL-LENGTH           PIC 999V99.
02      DCAR-FLUTE-LENGTH           PIC 999V99.
02      DCAR-BACK-TAPER PIC X(10).
02      DCAR-SIZE-TYPE  PIC X(2).
02      DCAR-AVAILABLE-ON-MC        PIC 99.
02      DCAR-TOOL-LIFE              PIC 9V9999.
02      DCAR-GRIND-TIME             PIC 999.
02      DCAR-NO-OF-GRINDINGS        PIC 99.
02      DCAR-TOOLSLOT-NO                PIC 9.
02      DCAR-TOOL-COST              PIC 9(4).
02      DCAR-MISCELANEOUS               PIC X(20).
RECORD NAME IS DRILL-CERAMIC-RECORD
        LOCATION MODE IS VIA DRILL-CERAMIC-SET
        WITHIN DRILL-AREA.

02      DCER-TOOL-NO                PIC 9(6).
02      DCER-TOOL-MATERIAL          PIC X(10).
02      DCER-TOOL-TYPE   PIC X(1).
02      DCER-HARDNESS    PIC X(1).
02      DCER-HOLDER-DETAILS         PIC X(10).
02      DCER-POINT       PIC 999V99.
02      DCER-HELITIX-RAKE           PIC 999V99.
02      DCER-LIP-CLEARENCE          PIC 999V99.
02      DCER-CHISEL-EDGE            PIC 999V99.
02      DCER-DIAMETER    PIC 999V99.
```

```
       02        DCER-TOTAL-LENGTH          PIC 999V99.
       02        DCER-FLUTE-LENGTH          PIC 999V99.
       02        DCER-BACK-TAPER PIC X(10).
       02        DCER-SIZE-TYPE   PIC X(2).
       02        DCER-AVAILABLE-ON-MC       PIC 99.
       02        DCER-TOOL-LIFE             PIC 9V9999.
       02        DCER-GRIND-TIME            PIC 999.
       02        DCER-NO-OF-GRINDINGS       PIC 99.
       02        DCER-TOOLSLOT-NO                  PIC 9.
       02        DCER-TOOL-COST             PIC 9(4).
       02        DCER-MISCELLANEOUS                PIC X(20).

RECORD NAME IS MILL-C-PLAIN-RECORD
       LOCATION MODE IS VIA MILL-C-PLAIN-SET
       WITHIN MILL-AREA.

       02        MCP-TOOL-NO                PIC 9(6).
       02        MCP-TOOL-MATERIAL          PIC X(10).
       02        MCP-FEED-TYPE              PIC X(2).
       02        MCP-TEETH-TYPE  PIC X(4).
       02        MCP-METHOD-CUTTER-MOUNT PIC X(10).
       02        MCP-RELIEF       PIC 999V99.
       02        MCP-PRIM-CLEARENCE         PIC 999V99.
       02        MCP-SEC-CLEARENCE          PIC 999V99.
       02        MCP-RAKE-RADIAL PIC 999V99.
       02        MCP-LIP PIC 999V99.
       02        MCP-ROOT-DIA     PIC 999V99.
       02        MCP-OUTSIDE-DIA PIC 999V99.
       02        MCP-NO-OF-TEETH PIC 99.
       02        MCP-WIDTH                   PIC 999V99.
       02        MCP-SIZE-TYPE    PIC X(2).
       02        MCP-AVAILABLE-ON-MC        PIC 99.
       02        MCP-TOOL-LIFE              PIC 9V9999.
       02        MCP-GRIND-TIME             PIC 999.
       02        MCP-NO-OF-GRINDINGS        PIC 99.
       02        MCP-TOOLSLOT-NO            PIC 9.
       02        MCP-TOOL-COST              PIC 9(4).
       02        MCP-MISCELLANEOUS                 PIC X(20).

RECORD NAME IS MILL-C-SIDE-RECORD
       LOCATION MODE IS VIA MILL-C-SIDE-SET
       WITHIN MILL-AREA.

       02        MCS-TOOL-NO     PIC 9(6).
       02        MCS-TOOL-MATERIAL          PIC X(10).
       02        MCS-FEED-TYPE   PIC X(2).
       02        MCS-TEETH-TYPE  PIC X(4).
```



```
       02        MCS-METHOD-CUTTER-MOUNT PIC X(10).
       02        MCS-PRI-FACE-CLEAR         PIC 999V99.
       02        MCS-PRI-PERIPHER-CLEAR     PIC 999V99.
       02        MCS-SEC-FACE-CLEAR         PIC 999V99.
       02        MCS-SEC-PERIPHER-CLEAR     PIC 999V99.
       02        MCS-RADIAL-RAKE PIC 999V99.
       02        MCS-FACE-RELIEF PIC 999V99.
```

```
02          MCS-PERIPHER-RELIEF         PIC 999V99.
02          MCS-LIP             PIC 999V99.
02          MCS-OUT-DIA         PIC 999V99.
02          MCS-ROOT-DIA        PIC 999V99.
02          MCS-CUTTER-WIDTH            PIC 999V99.
02          MCS-NO-OF-TEETH  PIC 99.
02          MCS-SIZE-TYPE     PIC X(2).
02          MCS-AVAILABLE-ON-MC         PIC 99.
02          MCS-TOOL-LIFE               PIC 9V9999.
02          MCS-GRIND-TIME              PIC 999.
02          MCS-NO-OF-GRINDINGS         PIC 99.
02          MCS-TOOLSLOT-NO             PIC 9.
02          MCS-TOOL-COST               PIC 9(4).
02          MCS-MISCELANEOUS                  PIC X(20).

RECORD NAME IS MILL-C-FACE-RECORD
       LOCATION MODE IS VIA MILL-C-FACE-SET
       WITHIN MILL-AREA.

02          MCF-TOOL-NO                 PIC 9(6).
02          MCF-TOOL-MATERIAL           PIC X(10).
02          MCF-FEED-TYPE     PIC X(2).
02          MCF-TEETH-TYPE    PIC X(4).
02          MCF-METHOD-CUTTER-MOUNT PIC X(10).
02          MCF-AXIAL-RAKE    PIC 999V99.
02          MCF-LIP           PIC 999V99.
02          MCF-FACE-CLEAR    PIC 999V99.
02          MCF-FACE-RELIEF   PIC 999V99.
02          MCF-PER-CLEAR     PIC 999V99.
02          MCF-PER-RELIEF    PIC 999V99.
02          MCF-RADIAL-RAKE   PIC 999V99.
02          MCF-NO-OF-TEETH   PIC 99.
02          MCF-ROOT-DIA      PIC 999V99.
02          MCF-OUT-DIA                 PIC 999V99.
02          MCF-SIZE-TYPE     PIC X(2).
02          MCF-AVAILABLE-ON-MC         PIC 99.
02          MCF-TOOL-LIFE               PIC 9V9999.
02          MCF-GRIND-TIME              PIC 999.
02          MCF-NO-OF-GRINDINGS         PIC 99.
02          MCF-TOOLSLOT-NO             PIC 9.
```



```
02          MCF-TOOL-COST               PIC 9(4).
02          MCF-MISCELANEOUS                  PIC X(20).

RECORD NAME IS MILL-OTHER-RECORD
       LOCATION MODE IS VIA MILL-OTHER-SET
       WITHIN MILL-AREA.
02          MO-TOOL-NO          PIC 9(6).
02          MO-TOOL-MATERIAL            PIC X(10).
02          MO-CUTTER-TYPE    PIC X(20).
02          MO-METHOD-CUTTER-MOUNT  PIC X(10).
02          MO-SPL-DETAILS    PIC X(20).
02          MO-SIZE-TYPE      PIC X(2).
02          MO-AVAILABLE-ON-MC          PIC 99.
02          MO-TOOL-LIFE                PIC 9V9999.
02          MO-GRIND-TIME               PIC 999.
02          MO-NO-OF-GRINDINGS          PIC 99.
02          MO-TOOLSLOT-NO              PIC 9.
02          MO-TOOL-COST                PIC 9(4).
02          MO-MISCELANEOUS             PIC X(20).
RECORD NAME IS BORE-C-CBORE-RECORD
       LOCATION MODE IS VIA BORE-C-CBORE-SET
       WITHIN BORE-AREA.
```

```
02        BCC-TOOL-NO                    PIC 9(6).
02        BCC-TOOL-MATERIAL                    PIC X(10).
02        BCC-TOOL-TYPE        PIC X(2).
02        BCC-RANGE-MIN        PIC 999V99.
02        BCC-RANGE-MAX        PIC 999V99.
02        BCC-DIA              PIC 999V99.
02        BCC-LENGTH1          PIC 999V99.
02        BCC-LENGTH2                    PIC 999V99.
02        BCC-SIZE-TYPE        PIC X(2).
02        BCC-AVAILABLE-ON-MC            PIC 99.
02        BCC-TOOL-LIFE                  PIC 9V9999.
02        BCC-GRIND-TIME                 PIC 999.
02        BCC-NO-OF-GRINDINGS            PIC 99.
02        BCC-TOOLSLOT-NO                PIC 9.
02        BCC-TOOL-COST                  PIC 9(4).
02        BCC-MISCELANEOUS                     PIC X(20).

RECORD NAME IS BORE-C-BORE-RECORD
     LOCATION MODE IS VIA BORE-C-BORE-SET
     WITHIN BORE-AREA.

02        BCB-TOOL-NO                    PIC 9(6).
02        BCB-TOOL-MATERIAL              PIC X(10).
```



```
02        BCB-TOOL-TYPE        PIC X(2).
02        BCB-ANGLE1           PIC 999V99.
02        BCB-ANGLE2           PIC 999V99.
02        BCB-LENGTH1          PIC 999V99.
02        BCB-DIA PIC 999V99.
02        BCB-RANGE-MIN        PIC 999V99.
02        BCB-RANGE-MAX        PIC 999V99.
02        BCB-SIZE-TYPE        PIC X(2).
02        BCB-AVAILABLE-ON-MC            PIC 99.
02        BCB-TOOL-LIFE                  PIC 9V9999.
02        BCB-GRIND-TIME                 PIC 999.
02        BCB-NO-OF-GRINDINGS            PIC 99.
02        BCB-TOOLSLOT-NO                PIC 9.
02        BCB-TOOL-COST                  PIC 9(4).
02        BCB-MISCELANEOUS                     PIC X(20).

RECORD NAME IS BORE-C-HOLD-RECORD
     LOCATION MODE IS VIA BORE-C-HOLD-SET
     WITHIN BORE-AREA.
02        BCH-TOOL-NO                    PIC 9(6).
02        BCH-TOOL-MATERIAL              PIC X(10).
02        BCH-TOOL-TYPE        PIC X(2).
02        BCH-TOOL-FINISH      PIC X(2).
02        BCH-TOOL-HEAD        PIC X(10).
02        BCH-TOOL-CUTTER      PIC X(10).
02        BCH-RANGE-MIN        PIC 999V99.
02        BCH-RANGE-MAX        PIC 999V99.
02        BCH-ANGLE1           PIC 999V99.
02        BCH-SIZE-TYPE        PIC X(2).
02        BCH-AVAILABLE-ON-MC            PIC 99.
02        BCH-TOOL-LIFE                  PIC 9V9999.
02        BCH-GRIND-TIME                 PIC 999.
02        BCH-NO-OF-GRINDINGS            PIC 99.
02        BCH-TOOLSLOT-NO                PIC 9.
02        BCH-TOOL-COST                  PIC 9(4).
02        BCH-MISCELANEOUS                     PIC X(20).

RECORD NAME IS BORE-C-INSERT-RECORD
     LOCATION MODE IS VIA BORE-C-INSERT-SET
     WITHIN BORE-AREA.
```

```
02          BXT-TOOL-NO                 PIC 9(6).
02          BXT-TOOL-MATERIAL           PIC X(10).
02          BXT-TOOL-TYPE      PIC X(2).
02          BXT-TOOL-FINISH    PIC X(2).
02          BXT-ANGLE1         PIC 999V99.
02          BXT-SIZE-TYPE      PIC X(2).
```

```
        02          BCI-AVAILABLE-ON-MC          PIC 99.
        02          BCI-TOOL-LIFE                PIC 9V9999.
        02          BCI-GRIND-TIME               PIC 999.
        02          BCI-NO-OF-GRINDINGS          PIC 99.
        02          BCI-TOOLSLOT-NO              PIC 9.
        02          BCI-TOOL-COST                PIC 9(4).
        02          BCI-MISCELANEOUS                       PIC X(20).

SET NAME IS TURN-SYS-SET
        MODE IS CHAIN
        ORDER IS ALWAYS NEXT
        OWNER IS SYSTEM
        MEMBER IS TURN-RECORD MANDATORY AUTOMATIC.

SET NAME IS TAP-SYS-SET
        MODE IS CHAIN
        ORDER IS ALWAYS NEXT
        OWNER IS SYSTEM
        MEMBER IS TAP-RECORD MANDATORY AUTOMATIC.

SET NAME IS DRILL-SYS-SET
        MODE IS CHAIN
        ORDER IS ALWAYS NEXT
        OWNER IS SYSTEM
        MEMBER IS DRILL-RECORD MANDATORY AUTOMATIC.

SET NAME IS BORE-SYS-SET
        MODE IS CHAIN
        ORDER IS ALWAYS NEXT
        OWNER IS SYSTEM
        MEMBER IS BORE-RECORD MANDATORY AUTOMATIC,

SET NAME IS MILL-SYS-SET
        MODE IS CHAIN
        ORDER IS ALWAYS NEXT
        OWNER IS SYSTEM
        MEMBER IS MILL-RECORD MANDATORY AUTOMATIC.

SET NAME IS REAM-SYS-SET
        MODE IS CHAIN
        ORDER IS ALWAYS NEXT
        OWNER IS SYSTEM
        MEMBER IS REAM-RECORD MANDATORY AUTOMATIC.

SET NAME IS GRIND-SYS-SET
        MODE IS CHAIN
        ORDER IS ALWAYS NEXT
```



```
        OWNER IS SYSTEM
        MEMBER IS GRIND-RECORD MANDATORY AUTOMATIC.

SET NAME IS TURN-HSS-SET
        MODE IS CHAIN LINKED TO PRIOR
```

```
        ORDER IS ALWAYS NEXT
        OWNER IS TURN-RECORD
        MEMBER IS TURN-HSS-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.

SET NAME IS TURN-CARBIDE-SET
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS TURN-RECORD
        MEMBER IS TURN-CARBIDE-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.

SET NAME IS TURN-CERAMIC-SET
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS TURN-RECORD
        MEMBER IS TURN-CERAMIC-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.

SET NAME IS REAM-HSS-SET
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS REAM-RECORD
        MEMBER IS REAM-HSS-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET..

SET NAME IS REAM-CARBIDE-SET
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS REAM-RECORD
        MEMBER IS REAM-CARBIDE-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.

SET NAME IS REAM-CERAMIC-SET
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS REAM-RECORD
        MEMBER IS REAM-CERAMIC-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.

SET NAME IS TAP-HSS-SET
```



```
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS TAP-RECORD
        MEMBER IS TAP-HSS-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.

SET NAME IS TAP-CERAMIC-SET
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS TAP-RECORD
        MEMBER IS TAP-CERAMIC-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.

SET NAME IS TAP-CARBIDE-SET
        MODE IS CHAIN LINKED TO PRIOR
        ORDER IS ALWAYS NEXT
        OWNER IS TAP-RECORD
        MEMBER IS TAP-CARBIDE-RECORD MANDATORY AUTOMATIC
        SET SELECTION IS THRU CURRENT OF SET.
```

```
*START* User GOPINATH [10100,100124]  Job  OUTMAT Seq. 4163 Date 20-Mar-86 08

*START* User GOPINATH [10100,100124]  Job  OUTMAT Seq. 4163 Date 20-Mar-86 08

*START* User GOPINATH [10100,100124]  Job  OUTMAT Seq. 4163 Date 20-Mar-86 08

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2345678901234567890123456789012345678901234567890123456789012345678901234567

                   APPENDIX-B
          SAMPLE LISTINGS AND REPORTS.

.EX MG.CBL
 [2:20:15]
 LINK:    Loading
 [LNKXCT SELCOV execution]
 [STATUS/AREA/RECORD/SET=     1500///]
 [JOURNAL CHARACTERISTICS ARE:]
 RUN-UNIT ID         0
 TOOL RUN         73
 17-MAR-86 02:29
 *      This program uses FLANK WEAR criterion for tool wear.
        The equation used is hf=C1*T**X1
        where T=the tool operation time in min.,hf=flank wear,and
        C1 and X1 are constants depending on the
        speed,feed and depth of cut
        usually 0.05 <= X1 <= 1.0.     *

    FOR THE JOB 01  OPERATION 01 ON M/C 1
    -------------------------------------

    please type in C1<9V9999>
 0.0030
    please type in X1<9V99>
 0.60
    FOR THE JOB 02  OPERATION 01 ON M/C 2
    -------------------------------------

    please type in C1<9V9999>
 0.0030
    please type in X1<9V99>
 0.60
    FOR THE JOB 01  OPERATION 02 ON M/C 5
    -------------------------------------

    please type in C1<9V9999>
 0.0030
    please type in X1<9V99>
 0.60
    FOR THE JOB 02  OPERATION 02 ON M/C 2
    -------------------------------------

    please type in C1<9V9999>
 0.0030
    please type in X1<9V99>
 0.60
    FOR THE JOB 03  OPERATION 01 ON M/C 6
    -------------------------------------
```

Please type in X1<4V999>
.0030
Please type in X1<9V99>
.60

****
* TOOL PLANNING AND CONTROL REPORTS *
****

****
* TOOL SCHEDULING REPORT *
****

TOOL NO	JOB NO	OP NO	M/C NO	FROM	TO
120597	01	01	1	0	30
120598	02	01	2	0	50
	02	02	2	60	80
120505	01	02	5	40	70
120507	03	01	6	50	80

TOTAL NO. OF TOOLS SELECTED =4

****
* TOOL REGRINDING REPORT *
****

TOOL NO	M/C NO	FROM	TO
120510	5	40	160

TOTAL NO. OF TOOLS SENT FOR REGRINDING=1

Page 3

****
* [illegible] REQUIREMENT FROM STOCK *
****

TOOL NO	M/C NO	FROM
120597	1	0
120608	2	0
120505	5	40

TOTAL NO. OF TOOLS PROCURED FROM STOCK =4

****
* TOOL SCRAP REPORT *
****

TOOL NO	M/C NO	FROM
120610	2	0

TOTAL NO. OF TOOLS SCRAPPED =1

****
* TOOL UTILIZATION REPORT *
****

TOOL NO	USAGE	UTILIZATION
120607	30	37.00
120608	70	87.00
120505	30	37.00
120507	30	37.00

****
* MACHINE UTILIZATION REPORT *
****

M/C NO	USAGE	UTILIZATION
1	30	37.00
2	70	87.00
3	30	37.00
[illegible]	30	37.00

TOTAL NO. OF M/CS USED =4

EXIT

01	1	01	000	030	1	[illegible]	155	155
02	1	02	000	055	1	[illegible]	155	155
01	2	05	010	030	1	[illegible]	155	155
02	2	02	060	020	[illegible]	[illegible]	155	155
03	1	06	050	030	[illegible]	[illegible]	155	155

```
*START* User GOPINATH [10100,100124]  Job  OUTRET Seq. 4162 Date 20-Mar-86 0
```


```
*START* User GOPINATH [10100,100124]  Job  OUTRET Seq. 4162 Date 20-Mar-86 0

*START* User GOPINATH [10100,100124]  Job  OUTRET Seq. 4162 Date 20-Mar-86 0
```


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12345678901234567890123456789012345678901234567890123456789012345678901234567
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```
.EX INF.CBL
[2:11:00]
LINK:    Loading
[LNKXCT RET execution]
[JOURNAL CHARACTERISTICS ARE:]
RUN-UNIT ID         0
TOOL RUN        72
17-MAR-86 02:11
MENU FOR INFORMATION RETRIEVAL
******************************
SELECT ANY ONE OF THE BELOW GIVEN OPTIONS
R -FOR INFORMATION ABOUT TOOLS SENT FOR GRINDING
S -FOR INFORMATION ABOUT TOOLS IN STOCK
M -FOR INFORMATION ABOUT TOOLS ON A M/C
T -FOR INFORMATION ABOUT TOOLS ON M/CS
   (SPECIFIC TOOL OR CATOGARY OF TOOLS OR SET OF TOOLS)
E -FOR EXIT <PRESS>
R
SELECT ANY ONE OF THE FOLLOWING:
1 -FOR INFORMATION OF TURNING TOOLS IN GRINDING
2 -FOR INFORMATION OF DRILLING TOOLS IN GRINDING
3 -FOR INFORMATION OF REAMING TOOLS IN GRINDING
4 -FOR INFORMATION OF TAPPING TOOLS IN GRINDING
5 -FOR INFORMATION OF MILLING TOOLS IN GRINDING
6 -FOR INFORMATION OF BORING TOOLS IN GRINDING
7 -FOR INFORMATION OF GRINDING TOOLS IN GRINDING
8 -FOR INFORMATION OF TOTAL TOOLS IN GRINDING
<PRESS>
1
        THE MENU
SELECT ANY  ONE OF THE FOLLOWING:
1 -FOR INFORMATION OF HSS TURNING TOOLS
2 -FOR INFORMATION OF CARBIDE TURNING TOOLS
3 -FOR INFORMATION OF CERAMIC TURNING TOOLS
4 -FOR INFORMATION OF ALL TURNING TOOLS
<PRESS>
4
TOOLNO    TOOLMATL    MCNO   TOOLLIFE   GRINDINGS  SLOTS  COST

120,608    HSS         99     0.1000        3        2     500
120,505    HSS         99     0.3100        3        3     500
142,501    CERAMIC     99     0.5000        1        1     1,500

TOTAL NO. OF TOOLS OF THE REQUIRED VARIETY=3

DO YOU WANT TO HAVE SOME MORE INFORMATION ABOUT
TURNING TOOLS IN GRINDING ?<Y or N>
```

```
N
DO YOU WANT TO HAVE SOME MORE INFORMATION ABOUT
TOOLS IN GRINDING ?<Y or N>
N
MENU FOR INFORMATION RETRIEVAL
******************************
SELECT ANY ONE OF THE BELOW GIVEN OPTIONS
R -FOR INFORMATION ABOUT TOOLS SENT FOR GRINDING
S -FOR INFORMATION ABOUT TOOLS IN STOCK
M -FOR INFORMATION ABOUT TOOLS ON A M/C
T -FOR INFORMATION ABOUT TOOLS ON M/CS
   (SPECIFIC TOOL OR CATOGARY OF TOOLS OR SET OF TOOLS)
E -FOR EXIT <PRESS>
S


SELECT ANY ONE OF THE FOLLOWING:
1 -FOR INFORMATION OF TURNING TOOLS IN STOCK
2- FOR INFORMATION OF DRILLING TOOLS IN STOCK
3 -FOR INFORMATION OF REAMING TOOLS IN STOCK
4 -FOR INFORMATION OF TAPPING TOOLS IN STOCK
5 -FOR INFORMATION OF MILLING TOOLS IN STOCK
6 -FOR INFORMATION OF BORING TOOLS IN STOCK
7 -FOR INFORMATION OF GRINDING TOOLS IN STOCK
8 -FOR INFORMATION OF TOTAL TOOLS IN STOCK
<PRESS>
2
          THE MENU
SELECT ANY  ONE OF THE FOLLOWING:
1 -FOR INFORMATION OF HSS DRILLING TOOLS
2 -FOR INFORMATION OF CARBIDE DRILLING TOOLS
3 -FOR INFORMATION OF CERAMIC DRILLING TOOLS
4 -FOR INFORMATION OF ALL DRILLING TOOLS
<PRESS>
1

NO RECORDS FOUND !

DO YOU WANT TO HAVE SOME MORE INFORMATION ABOUT
DRILLING TOOLS IN STOCK    ?<Y or N>
N
DO YOU WANT TO HAVE SOME MORE INFORMATION ABOUT
TOOLS IN STOCK    ?<Y or N>
N
MENU FOR INFORMATION RETRIEVAL
******************************
SELECT ANY ONE OF THE BELOW GIVEN OPTIONS
R -FOR INFORMATION ABOUT TOOLS SENT FOR GRINDING
S -FOR INFORMATION ABOUT TOOLS IN STOCK


M -FOR INFORMATION ABOUT TOOLS ON A M/C
T -FOR INFORMATION ABOUT TOOLS ON M/CS
   (SPECIFIC TOOL OR CATOGARY OF TOOLS OR SET OF TOOLS)
E -FOR EXIT <PRESS>
M
PLEASE TYPE IN THE M/C NO. ON WHICH YOU WANT
[illegible]
                                                   [illegible]
                                                   1,000
                                                   1,000
```

340,506	CERAMIC	1	[illegible]	1	1	2,500
440,610	CERAMIC	1	0.0050	2	1	2,500
621,007	CARBIDE	1	0.0100	5	1	1,000
740,510	CARBIDE	1	0.1000	0	1	1,000
750,110	CARBIDE	1	0.0010	12	5	99

TOTAL NO. OF TOOLS OF THE REQUIRED VARIETY=11

DO YOU WANT TO GET INFORMATION OF TOOLS AVAILABLE
ON SOME OTHER M/C. S?<Y or N>
N
MENU FOR INFORMATION RETRIEVAL
****
SELECT ANY ONE OF THE BELOW GIVEN OPTIONS
R -FOR INFORMATION ABOUT TOOLS SENT FOR GRINDING

S -FOR INFORMATION ABOUT TOOLS IN STOCK
M -FOR INFORMATION ABOUT TOOLS ON A M/C
T -FOR INFORMATION ABOUT TOOLS ON M/CS
(SPECIFIC TOOL OR CATOGARY OF TOOLS OR SET OF TOOLS)
E -FOR EXIT <PRESS>
T
SELECT ANY ONE OF THE FOLLOWING:
1 -FOR INFORMATION ABOUT A TOOL
2 -FOR INFORMATION ABOUT A SET OF TOOLS
3 -FOR INFORMATION ABOUT A TYPE OF TOOLS <PRESS>
1
PLESE TYPE IN THE TOOL NO<9(6)>
120510

TOOLNO	TOOLMATL	MCNO	TOOLLIFE	GRINDINGS	SLOTS	COST
120,510	HSS	5	0.0001	2	3	500

DO YOU WANT TO HAVE INFORMATION ABOUT
ANY OTHER TOOL ?<Y or N>
N
DO YOU WANT TO HAVE ANY OTHER INFORMATION
ABOUT TOOLS ON M/CS ? <Y or N>
Y
SELECT ANY ONE OF THE FOLLOWING:
1 -FOR INFORMATION ABOUT A TOOL
2 -FOR INFORMATION ABOUT A SET OF TOOLS
3 -FOR INFORMATION ABOUT A TYPE OF TOOLS <PRESS>
2
GIVE THE SET NO. OF THE TOOLS ABOUT WHICH
YOU WANT TO GET INFORMATION <9(4)>
1210

TOOLNO	TOOLMATL	MCNO	TOOLLIFE	GRINDINGS	SLOTS	COST
121,001	HSS	4	0.1000	0	1	1,000
121,010	HSS	[illegible]	0.0555	2	1	1,000
121,015	HSS	[illegible]	0.2000	1	1	1,000

TOTAL NO. OF [illegible] VARIETY=3
[illegible] ABOUT ANY
[illegible]
[illegible] INFORMATION

```
SELECT ANY ONE OF THE FOLLOWING:
1 -FOR INFORMATION OF TURNING TOOLS IN MACHINES
2- FOR INFORMATION OF DRILLING TOOLS IN MACHINES
3 -FOR INFORMATION OF REAMING TOOLS IN MACHINES
4 -FOR INFORMATION OF TAPPING TOOLS IN MACHINES
5 -FOR INFORMATION OF MILLING TOOLS IN MACHINES
6 -FOR INFORMATION OF BORING TOOLS IN MACHINES
7 -FOR INFORMATION OF GRINDING TOOLS IN MACHINES
8 -FOR INFORMATION OF TOTAL TOOLS IN MACHINES
<PRESS>
2
        THE MENU
SELECT ANY ONE OF THE FOLLOWING:
1 -FOR INFORMATION OF HSS DRILLING TOOLS
```

```
2 -FOR INFORMATION OF CARBIDE DRILLING TOOLS
3 -FOR INFORMATION OF CERAMIC DRILLING TOOLS
4 -FOR INFORMATION OF ALL DRILLING TOOLS
<PRESS>
4
TOOLNO    TOOLMATL    MCNO  TOOLLIFE  GRINDINGS  SLOTS  COST

220,508   HSS           1    0.0500       1        1    1,000
230,508   CARBIDE       1    0.0500       1        1    1,000
241,010   CERAMIC       1    0.0500       1        1    1,000

TOTAL NO. OF TOOLS OF THE REQUIRED VARIETY=3

DO YOU WANT TO HAVE SOME MORE INFORMATION ABOUT
DRILLING TOOLS IN MACHINES ?<Y or N>
N
DO YOU WANT TO HAVE INFORMATION ABOUT ANY OTHER
TYPE OF TOOLS ON M/CS ?<Y or N>
N
DO YOU WANT TO HAVE ANY OTHER INFORMATION
ABOUT TOOLS ON M/CS ? <Y or N>
N
MENU FOR INFORMAITON RETRIEVAL
******************************
SELECT ANY ONE OF THE BELOW GIVEN OPTIONS
R -FOR INFORMATION ABOUT TOOLS SENT FOR GRINDING
S -FOR INFORMATION ABOUT TOOLS IN STOCK
M -FOR INFORMATION ABOUT TOOLS ON A M/C
T -FOR INFORMATION ABOUT TOOLS ON M/CS
   (SPECIFIC TOOL OR CATOGARY OF TOOLS OR SET OF TOOLS)
E -FOR EXIT <PRESS>
E
EXIT
```